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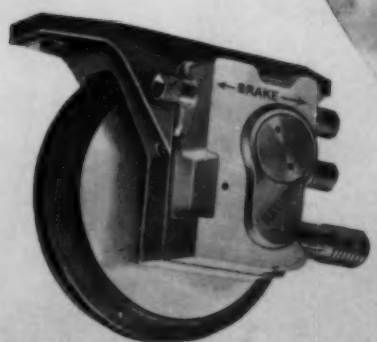

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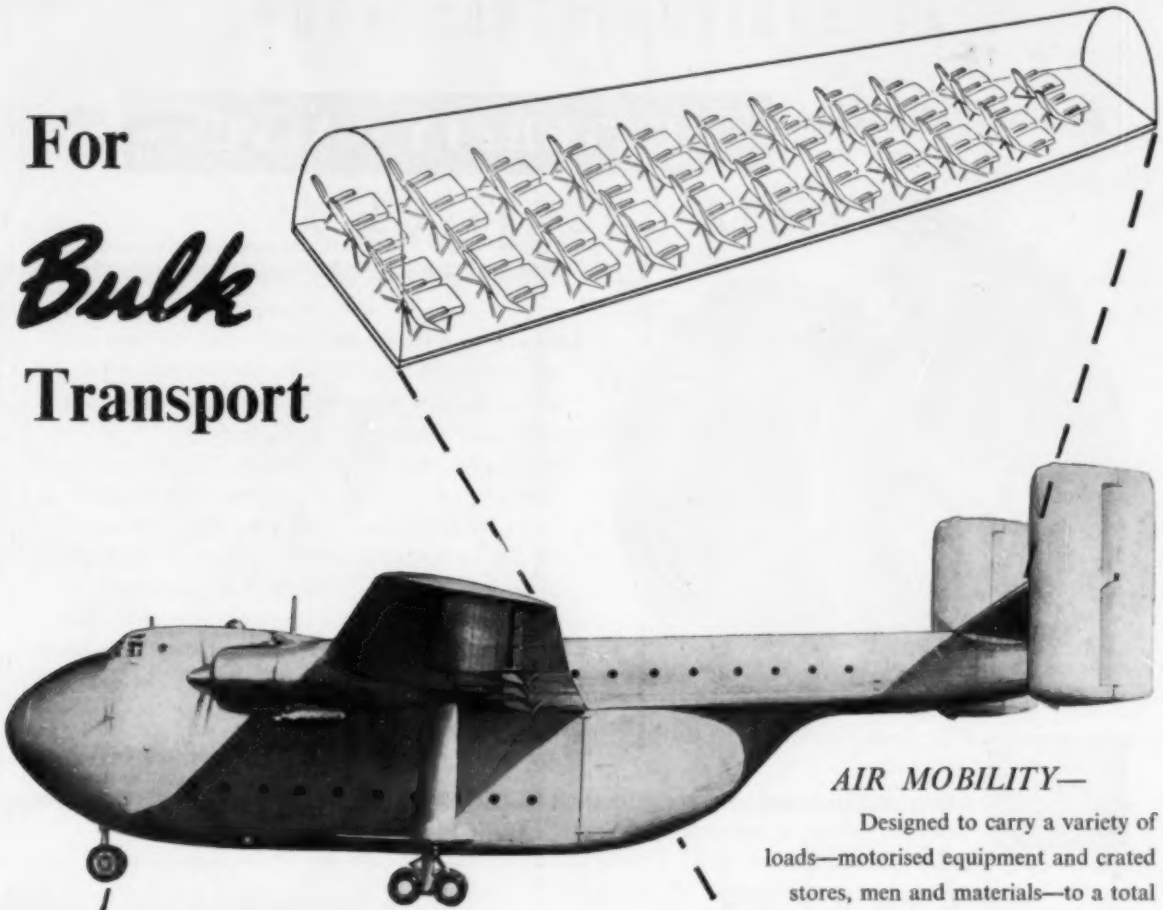

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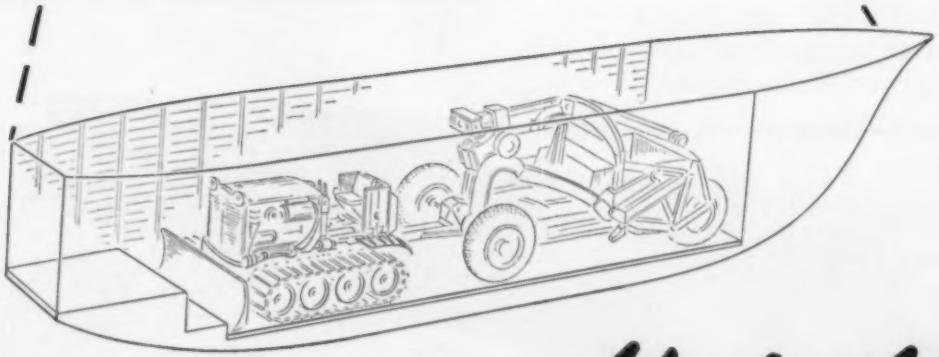

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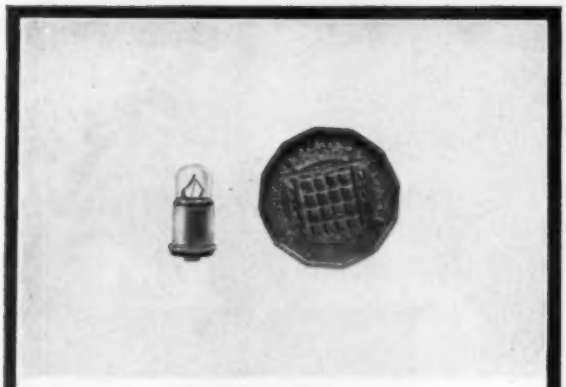

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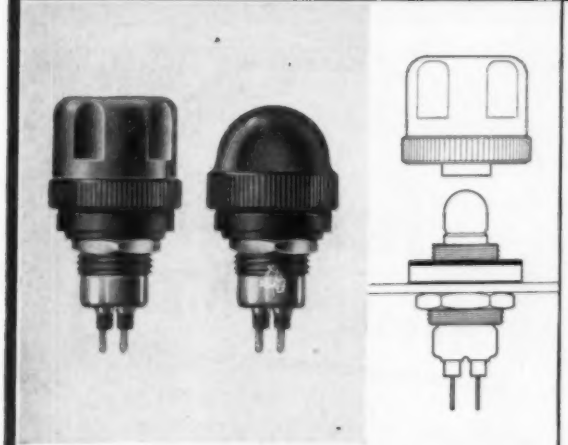

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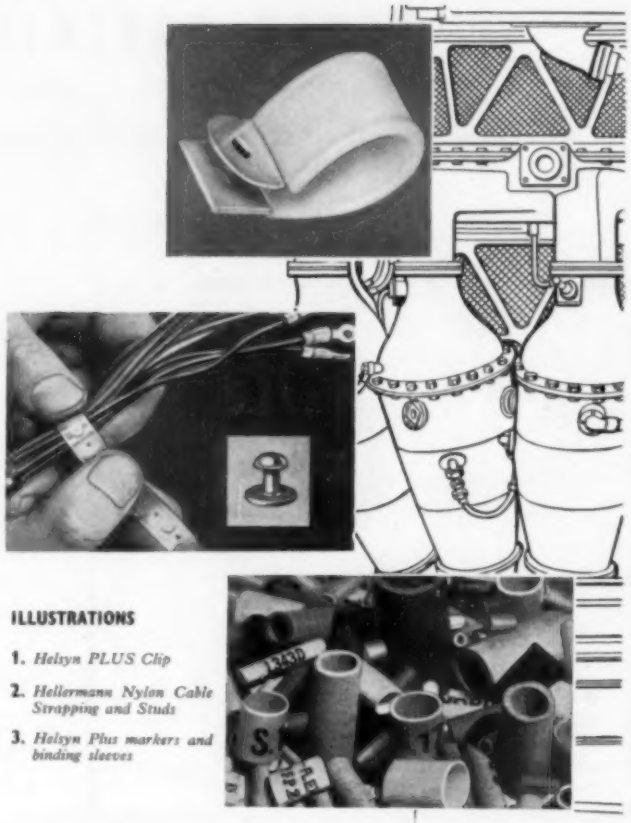

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1. *Helsyn PLUS Clip*
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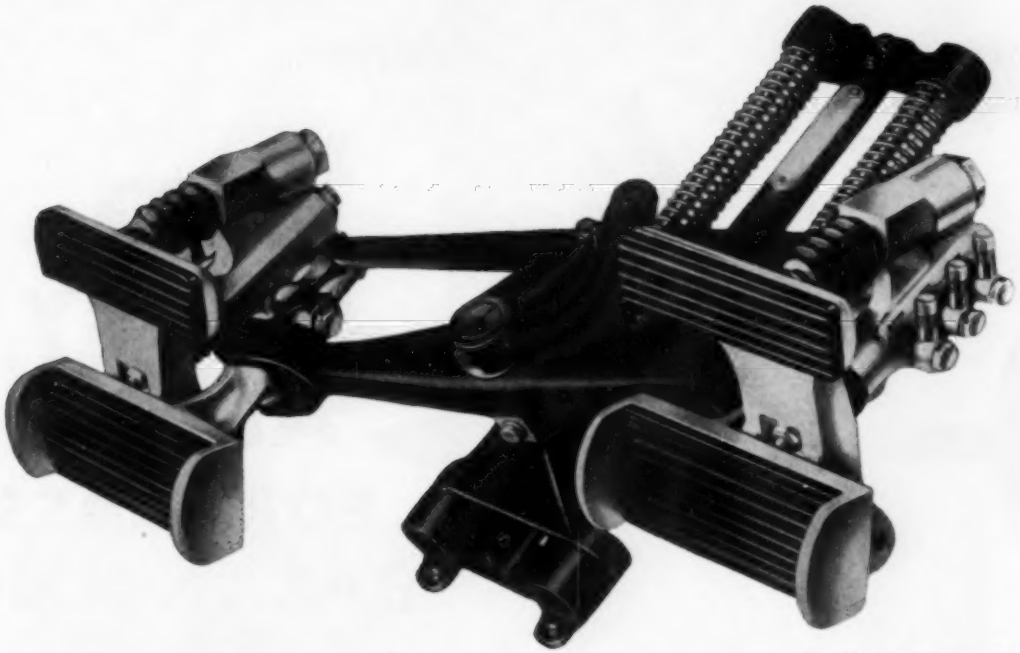

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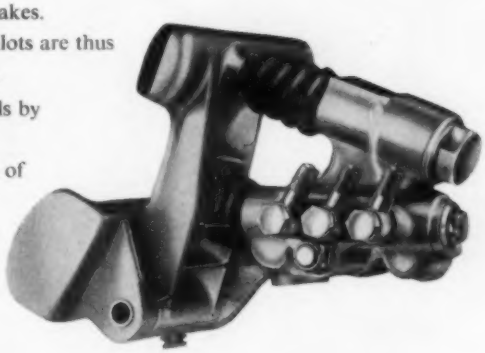

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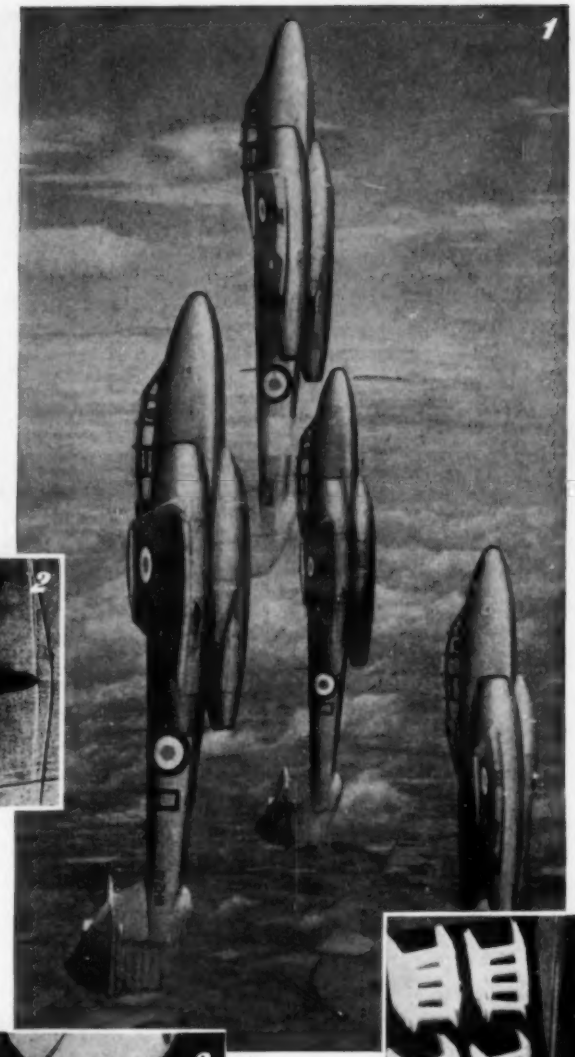

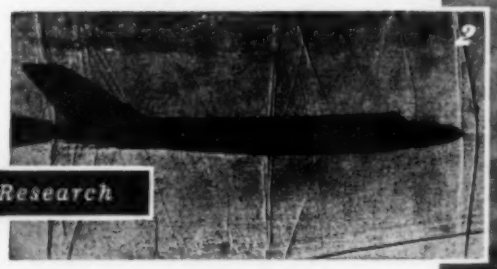

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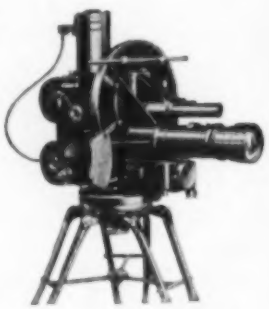

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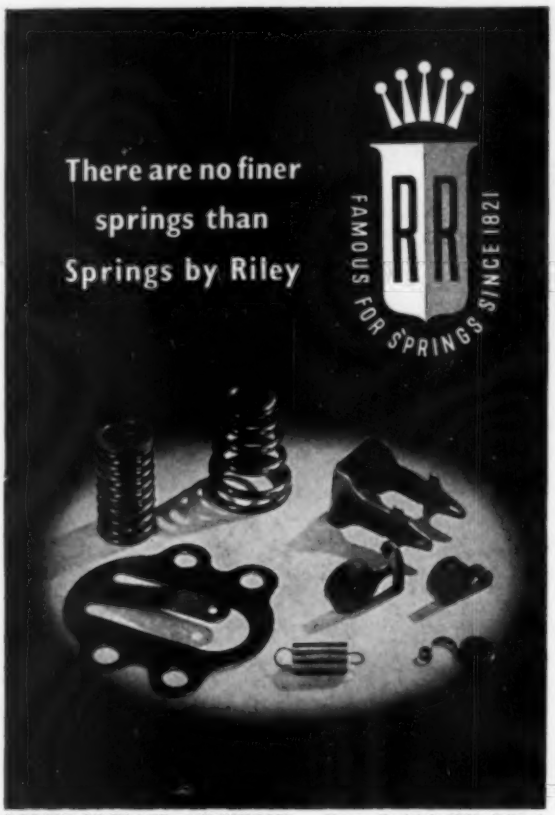

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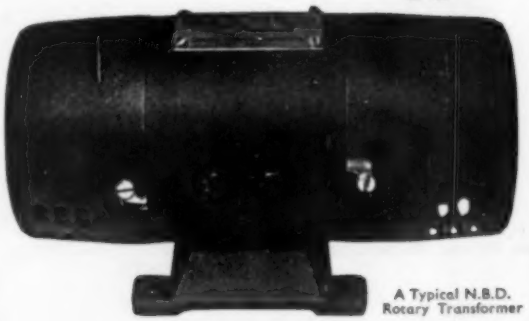

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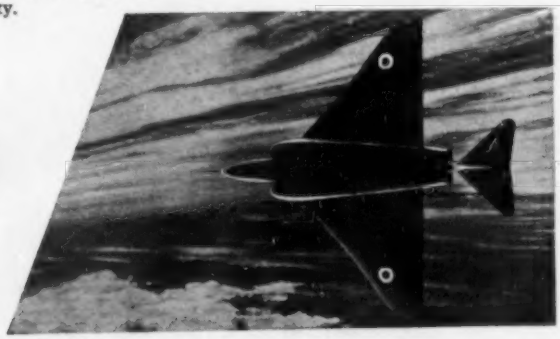

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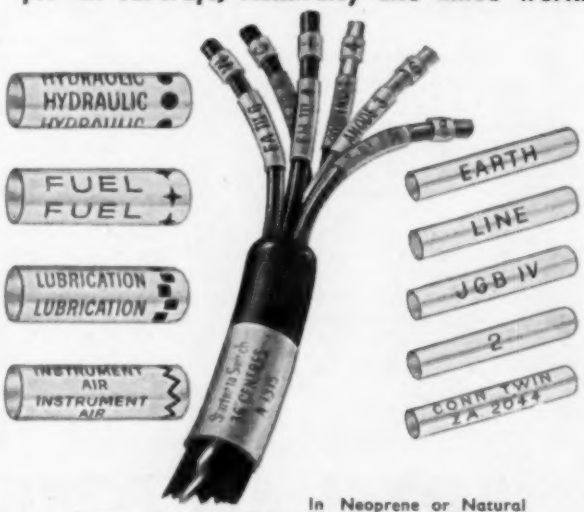

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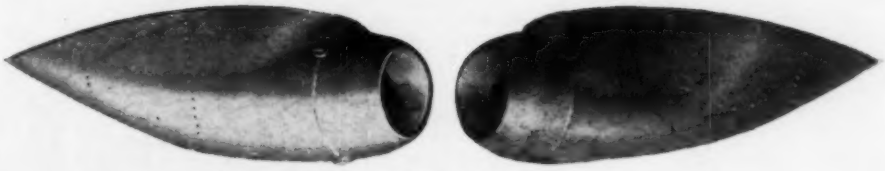

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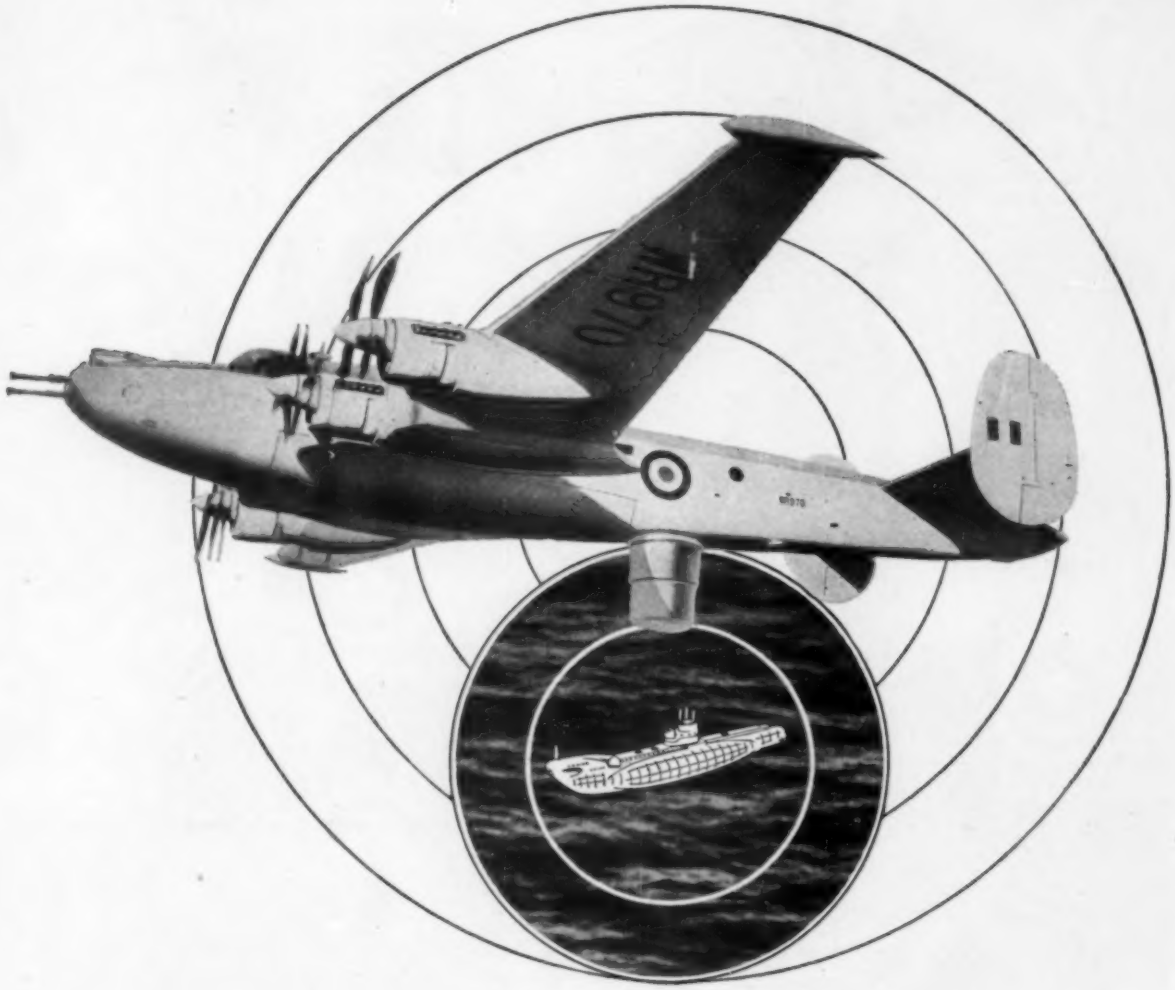

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Canada Forges Ahead

HELP to a mother country in times of trial and trouble has never been given more readily and generously than by Australia, Canada and the other Commonwealth nations to Great Britain. Until the later stages of the last war, such aid had not included much war material, simply because the countries concerned were not geared to produce it. Even in the early 1940s it took time to build up to large-scale production in the Dominions, although once the flow started—and aircraft were the outstanding example—its volume was beyond all expectations. To fill in the many gaps in equipment in two great wars, the English-speaking nations turned gratefully to the United States for anything that her great industries might agree to wheel across the border or swing aboard British ships.

Since the war, circumstances have been changing; now eyes are turned also to Canada, where a great new aircraft industry is growing up and preparing to shoulder a man's share of the responsibility hitherto carried by the manufacturers in these islands. This is not only a logical development in a vigorous young country rich in natural assets, but it also reflects in part a deliberate strategic policy to spread aircraft manufacturing potential. One organization more than any other has been responsible for these rapid developments—we refer to Avro Canada, recently reorganized into a Canadian group with a constitution rather similar to that of its own parent in England. To the Home Country this group represents an investment of 16 million dollars and some hundreds of first-class men, including many with skill and experience that can ill be spared.

Aircraft manufacturers, of course, rely upon a variety of specialized supporting firms for their materials and equipment, and the interdependency between the two is very great. Parallel with the development of the Avro Canada organization, and to a great extent springing from it, has been that of the ancillary aircraft industry in Canada. Its extent will be known to those of our readers who recall our Commonwealth Aircraft Industries special number of August 27th last. It is no mean achievement to have built up in the few years since the war, an organization which, with the help of these ancillary suppliers, could design, produce and put into service an outstanding all-weather fighter like the CF-100 and, in addition, the engines with which it is powered. As recent reports make clear, this is only the beginning, and, moreover, it is by no means all that has been done—as, for example, the Jetliner and the recent order for the CF-105 confirm.

Naturally enough, with such a powerful and influential neighbour just across her borders, Canada has been much influenced by American thought and method, and the second great company in Canadian aviation, Canadair, Ltd., is American controlled and at present builds American fighters and jet trainers, though the former use the Canadian Orenda engine and the latter Rolls-Royce Nenes. Canadair is not tied to America regardless of all other considerations, and the significance of the order now in hand for a long-range maritime-reconnaissance variant of the Bristol Britannia has perhaps been less appreciated than it deserves. The Britannia airframe was selected by the Canadian Government as being the most suitable and efficient after competitive studies had been made of several possibilities—including, we believe, a Douglas proposal. This is worth bearing in mind when giving thought to the Britannia/DC-7 controversy, though in the case of the M.R. order the engine question associated with the civil types had no influence on the deliberations. The M.R. Britannia is to have four piston engines of American manufacture.

In the coming years it is to be expected that British manufacturers will play an increasing part in the further development of the aviation industries of Canada and of Australia. The sizeable British firm which has no branch or associate in one or more of these Commonwealth countries is already coming to be regarded as an exception. This state of affairs is very much to the mutual benefit of the two nations in peace or in war. It ensures co-operation instead of competition and ensures it where co-operation can be most advantageous. By a free exchange of knowledge, ideas and experience it enables more to be attempted with the available resources. Especially, as we remarked on an earlier occasion, it helps to give the British peoples strength in depth.

FROM ALL QUARTERS

Canada's "Saucer"

ON arrival at Southampton on December 2nd, Mr. C. D. Howe, Canadian Minister of Trade, Commerce and Defence Production, told reporters that Canadian scientists had worked for twelve months on a "flying saucer" project. "We did engineering on it and proved to ourselves that it would fly," he said, "but we did not carry it to the mock-up stage because it did not seem to have any useful purpose." Mr. Howe was quoted as saying on the same occasion that the project had cost about $100 million to develop, but it was later explained from Canada House that what the Minister had meant to say was that it *would have* cost about $100 million to develop.

Mr. Howe also disclosed that the aircraft was oval-shaped, "with exhaust pipes not unlike some of the drawings which have appeared in magazines."

It is clear from what the Minister said that he was referring to "Project Y," the work of Mr. J. C. M. Frost, special projects chief design engineer of A. V. Roe Canada. Some notes on this project were given in our issue of August 27th.

NATO Chooses Fouga Magister

AT a conference in Paris on November 26th, M. Chasles, president and director-general of the Fouga company, announced that the Fouga 170.R Magister twin-jet trainer had been selected by the NATO authorities as the most suitable aircraft for both basic and advanced flying training in the NATO air forces. The decision was made after a demonstration of training aircraft designed to meet NATO specifications and held at Villacoublay, Paris, on July 22nd; it followed, also, a conference by the Air Training Advisory Group of NATO in London in August.

The Magister is a tandem two-seater with a butterfly tail, powered by two Turboméca Marborés of 880 lb thrust each.

Supply Minister at Filton

IN the course of an all-day visit to the Bristol Aeroplane Co. at Filton on December 2nd, the Minister of Supply, Mr. Selwyn Lloyd, flew for nearly an hour in the first production Britannia. He said that he had found the Britannia a very comfortable aeroplane and he believed that it had a great commercial future. He added, "Everything I have seen here today has confirmed our belief in the energy and competence of this company." His deputy-secretary, Mr. L. J. Dunnett, replied to a question: "So far as the Ministry is concerned, I don't see how we can help the company to go any faster."

Referring to the pressure-cabin tests to be carried out at Farnborough, Mr. Selwyn Lloyd said that the Ministry would do everything it could to speed them up.

Sir Reginald Verdon Smith, joint managing director of the Bristol Aeroplane Co., said that the target date for Britannia certification was mid-1955. After that, the aircraft (Mk 100s) now being manufactured should be delivered progressively to B.O.A.C. "Quite a few" would reach the Corporation in 1955, and the balance of the Mk 100s should be delivered early in 1956. Mk 300s for B.O.A.C. and other customers would follow. The first of the Mk 300s with the newly developed BE25 turboprop, Sir Reginald added, "will emphatically be ready before the first Douglas turboprop."

German Aircraft—When?

ACCORDING to the *Sunday Times*, the Bonn Government is being asked by West German industrialists to support the building of factories to produce British and American aircraft under licence as soon as Germany regains its sovereignty. The scheme, it is reported, is being actively canvassed by members of the Society of German Aircraft Manufacturers, and in particular by Herr Willi Messerschmitt.

These plans have found little support in Government circles so far—an estimated £100 million would be required to re-form the dispersed aircraft industry—and a note of caution was sounded by Professor Ernst Heinkel in Stuttgart last week. Speaking at a meeting of aeronautical research heads and aircraft manufacturers, he said that Germany could not hope to re-start her aircraft factories without extensive help from other countries.

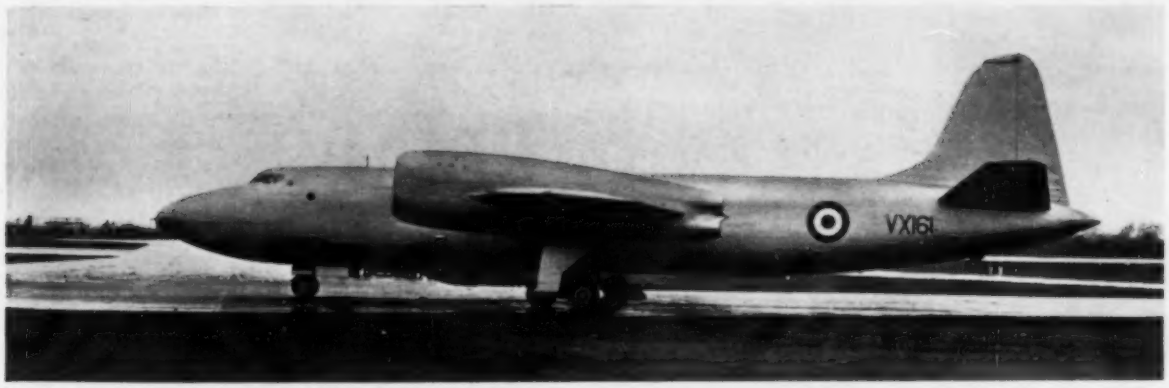
Other opinions on this subject were expressed at Wiesbaden by Herr Rohde, a former director of the Junkers aircraft company, and Prof. Leo Brandt, State Secretary for Transport of North Rhine-Westphalia. Herr Rohde said that at least four years would elapse before the German aircraft industry would be able to produce an original aircraft. Foreign aircraft and engines would probably be built under licence first, said Prof. Brandt, who went on to suggest that the German aircraft industry should begin by concentrating on light aircraft and helicopters, for which types a considerable export market existed.

THE GRAND MASTER: Unveiled at a G.A.P.A.N. ceremony last week (see page 846) was this portrait of the Duke of Edinburgh. It is the work of S. Morse-Brown, to whom His Royal Highness gave four sittings. Other sitters to the same artist have been Air Marshal Broadhurst, General Cannon, U.S.A.F, Air Marshal Coningham, Air Chief Marshal Dickson, Air Marshal Elmhirst and General Spaatz.

Landing Fees—A Welcome Concession

THOSE light-aircraft pilots who have been forced to make emergency landings at M.T.C.A. aerodromes, only to be immediately charged 15s. for the privilege, will have an especial if cynical feeling of relief at the landing-fee concession announced by Mr. Boyd-Carpenter on Friday last. In future, he said, light aircraft belonging to the flying clubs would be allowed to land free of charge at State airfields, and the £5 "season tickets" would be abolished. This was an indication of the high value which the Ministry placed on the flying-club movement. The Minister's announcement was made at the annual dinner of the Association of British Aero Clubs and Centres, which is reported on page 850.

IMPRESSED: Mr. Selwyn Lloyd, Minister of Supply, flew for nearly an hour in the first production Britannia last week. His verdict: "A very comfortable aeroplane." The Minister, whose visit to Filton is reported on this page, is pictured (right) in the Britannia's cockpit with Bristol's assistant chief test pilot, Walter Gibb.



SPERRIN, the name which has been conferred on the Short S.A.4, will be found in no dictionary; it denotes a lofty range of mountains about 40 miles west of the company's Belfast factory. This recent photograph shows the second Sperrin; one of the two completed will shortly be fitted for flight-testing the de Havilland Gyron turbojet. Basic power plants are Rolls-Royce Avon RA.3s, in "double-banked" nacelles.

Empire Test Pilots' Graduation

ONCE again the time has come for another course of Empire Test Pilots—the thirteenth—to pass out from Farnborough. The annual McKenna Trophy Dinner marking the occasion took place last Friday, and a precedent was created in awarding the McKenna Trophy for the most successful student jointly to Capt. R. Bignamini, of the Italian Air Force, and F/L. V. Hill, D.F.C., of the R.A.A.F. In addition to the two winners there were four distinguished passes. The Commandant, G/C. S. Wroath, A.F.C., reviewed the year's achievements, and Admiral Caspar John, C.B., Deputy Controller of Aircraft, presented the Trophy. This important occasion will be referred to more fully next week.

Beverley Progress

HITHERTO security-classified, performance data (similar to that for the civil Universal) may now be published for the Blackburn Beverley C.1. This great aircraft is in small-series production for the R.A.F. It is a versatile heavy transport, intended principally for lifting—and, if need be, air-dropping—all types of freight. It has excellent short-field characteristics (which can be further improved by a pair of Super Sprite rockets) and does not require prepared runways.

The Beverley C.1 is powered by four 2,850 h.p. Bristol Centaurus 173s. The span, length and height of the aircraft are, respectively, 162ft, 99ft 2in and 38ft 5in, and the gross wing area is 2,916 sq ft. The basic equipped weight is at present some 78,900 lb and, with 135,000 lb a.u.w., 56,000 to 58,000 lb is available for fuel, oil and payload.

Experience with the second prototype WZ 889 indicates that stages of over 250 miles will be possible with a freight load of 46,800 lb (volumetric capacity is 7,100 cu ft), and stages exceeding 1,000 miles with 35,000 lb, in each case with reserve fuel for a 230-mile diversion, plus 15-min stand-off, plus 5 per cent. The recommended cruising speed is 175 m.p.h.; maximum W.M. speed is 194 m.p.h., maximum continuous, 223 m.p.h. and maximum speed, 238 m.p.h. The balanced field-length is of the order of 1,100 yd.

The speed of Beverley development has been well above average. The programme for the original Hercules-powered Blackburn and General Type 60 (of which the prototype flew in June 1950) was cancelled by the previous Government, and work was virtually abandoned for some two years. The present Model 65 is an 80 per cent redesigned aircraft, yet it has already completed makers' and Boscombe trials (with great success), and the first production machine should fly next month. This aircraft should finish its trials next summer, by which time the second machine will be flying.

The gap of six months between the first and second production machines is not representative of the eventual rate of output: were orders to be increased, capacity is available for double the production rate now planned. Such an increase is likely and, moreover, the civil prospects for the Beverley are brighter than at any previous time.

The Short Sperrin

AS noted in the caption to the photograph on this page, the bluff Short S.A.4 has been named Sperrin. Designed to Specification B.14/46, the Sperrin was basically an insurance against any failure of the Valiant to meet its later specification. Promising progress with the swept-wing bomber of higher performance explains the fact that the Sperrin was not put into production. Three were built, one of which was used for exhaustive static tests. The two completed, VX 158 and VX 161, have since undertaken much experimental and development work of great consequence.

Powered by four Rolls-Royce Avon RA.3 turbojets of some 6,500 lb thrust each, mounted in unusual "double-banked" nacelles, the Sperrin has a span of 109ft, a length of 102.2ft, a wing area of 1,897 sq ft, and an aspect ratio of 6.27 (on the low side). The normal all-up weight is 115,000 lb (with a design ultimate of 4.0) giving a wing loading of 60.6 lb/sq ft. The 996 cu ft bomb-bay can take a 20,000 lb load, the internal fuel capacity being 6,060 gallons. With a 10,000 lb bomb load, the operational range in still air is 3,350 nautical miles (3,860 statute miles), with an over-target height of 45,000ft. Design diving speed was 390 kt E.A.S., and the maximum cruising speed is 435 kt at 40,000ft. At 15,000ft the maximum level speed is 490 kt (564 m.p.h.). The design maximum Mach number is 0.85.

The Avro Canada Re-organization

LAST week we recorded the announcement, made by Sir Frank Spriggs, of the re-organization of the Hawker Siddeley Group's Canadian interests. Two new companies, Avro Aircraft, Ltd., and Orenda Engines, Ltd., have been formed to take over, respectively, the aircraft and engine production of A. V. Roe Canada, Ltd., which now becomes the parent company. Canadian Steel Improvement, Ltd., acquired by the Group last April, has been brought under Avro Canada control.

It is now possible to give details of new executive appointments arising from the re-organization. In Avro Canada, A. A. Bailie is appointed vice-president finance and W. H. Dickie vice-president industrial relations. In Avro Aircraft, J. C. Floyd becomes vice-president engineering, H. R. Smith vice-president manufacturing and J. A. Morley vice-president sales and service. In addition, Joseph Turner is appointed secretary and treasurer. In Orenda Engines, C. A. Grinyer becomes vice-president engineering, E. K. Brownridge vice-president manufacturing and F. L. Tretheway, vice-president sales and service; K. R. Church

PARIS MODEL: Last week M. Lafay, Lord Mayor of Paris, laid the foundation stone of a £1.5m heliport for the French capital. Shown here in model form, the heliport will consist of a terminal capable of handling 1,000 passengers daily and a roof-top helicopter platform. It is located near the Bir Hakeim Metro Station, only "five minutes' medium driving" from the Champs Elysées.

FROM ALL QUARTERS . . .

is appointed secretary and treasurer. In Canadian Steel Improvement, J. A. Wellings is made vice-president operations.

Heads of the three companies are Fred T. Smye (Avro Aircraft), Walter R. McLachlan (Orenda) and Cyril J. Luby (C.S.I.).

Sapphire's 10,200 lb Rating

THAT something extraordinary in the way of thrust ratings was bound to be promulgated for the Armstrong Siddeley Sapphire turbojet was evident from the performance of the Sapphire 7 Canberra test-bed, demonstrated at the S.B.A.C. Display this year. The figure has now been disclosed as 10,200 lb "dry", i.e., without water-injection or reheat. Approval for production has been given by the Ministry of Supply.

Deliveries of the Sapphire 6 from the Brockworth Engineering Company and Armstrong Siddeley's own factory at Coventry have already been made for Hawker Hunter and Gloster Javelin fighters and the Handley Page Victor bomber. Sapphires of an unspecified mark are installed in the English Electric P.1. In America over 2,000 engines of the same type (known there as Wright J65s) have been delivered to the U.S.A.F.

Armstrong Siddeley Motors, Ltd., claim that the Sapphire 7 retains the surge-free handling, rapidity of response and good high-altitude fuel economy for which the Sapphire 6 has already won a good reputation. Specific fuel-consumption corresponding to the sea-level static thrust rating of 10,200 lb is 0.885 lb/hr/lb thrust, net dry weight is 2,972 lb, diameter over trunnion mountings 37.4in, and overall length 127.6in. From the photograph below it will be seen that the Sapphire 7 bears a strong likeness to the 6, the most obvious difference being the larger diameter of the compressor entry. Overall frontal area is said to show no increase over that of the Sapphire 6.

A Wonderful Film

THIRTEEN minutes, rich in the colour and drama of this year's S.B.A.C. Display, and with sequences of transcendent beauty, is *This Supersonic Age*, to be released by Twentieth Century-Fox. In part the magnificence of the film might be attributed to the CinemaScope camera itself; but be that as it may, the photographic technique of Mr. Paul Wyland and Mr. David Samuelson (especially Mr. Samuelson's air-to-air sequences from the Fairchild Packet) merits the warmest praise. All in all, the film is a milestone in aeronautical documentation—a superb record of a great occasion with faithful, intimate and moving portraits of the aircraft engaged. A film, in brief, that will enthral everyone and send true lovers of the air into transports of delight.

Ramjet Progress

WHEN the Art Editor passed through Istres (the great airfield on the Etang de Berre, near Marseilles, corresponding to our Boscombe Down) last week, he saw tangible evidence of progress with the unique series of ramjet aircraft being developed for the French Government by M. René Leduc. All the Leduc designs, it may be recalled, have a large duct-like fuselage forming the ramjet, the pilot and most equipment being contained within a nacelle mounted at the centre of the intake.

At present most of the effort is being applied to the Leduc 021, which has been flying since May 1953, and the 022, which will fly next year.

The 021 has a fuel tank on the tip of each wing, and is air-launched from a Languedoc four-engined transport, on which it is mounted atop a large cradle. The ramjet does not light-up until the air-speed is approximately 185 knots, and "ground runs" are therefore carried out at an indicated speed equal to, or greater than, this value, at a height of 12,000ft or more. On such "ground runs," the Leduc aircraft remains attached to the Languedoc. A large number of free flights have been made, with speeds in the transonic range. At present, the 021 is making several flights each week.

The Leduc 022 will be fitted with a turbojet on each wing tip, and will therefore be able to take off under its own power. Designed for a Mach number of about 2, it will be a prototype fighter, and will be rather larger than previous machines of this series.

Also seen at Istres were two other cradle-fitted Languedocs, one of which was carrying out reheat trials on an Atar turbojet, and a curious Martin Marauder which appeared to be fitted with a fuselage-mounted turbojet with a propelling nozzle in the extreme tail. One of the Vautour prototypes was airborne at the time, and this fine twin-jet machine made its presence known by a sonic bang.

Capt. F. R. Walker

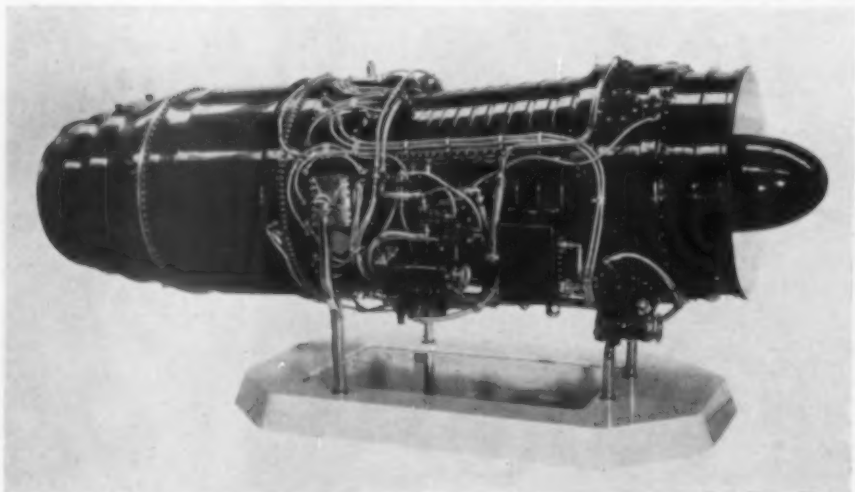
WE regret to learn that Capt. F. R. Walker, of the de Havilland Aircraft Co., Ltd., died on November 29th after a long illness. Since August 1953 he had been deputy to the production director engaged on civil types of aircraft. Born in New Zealand and educated at Winchester, Roy Walker served in the R.F.C. and R.A.F. in World War I; he was awarded the D.F.C. and Bar. After leaving the Service he joined the Aircraft Disposal Board (later the Aircraft Disposal Co.) and, at the Croydon factory, was responsible in 1924 for the manufacture of the Cirrus engine, as used in the first Moth. From 1928 to 1934 he was in charge of operations and engineering on Imperial Airways' African and Eastern routes. In 1934 he went to Teheran to organize a factory for the production of Tiger Moths under licence for the Iranian Air Force. In 1937 he rejoined Imperials, where he was in charge of the flying-boat base at Hythe; and in 1940, on the formation of the B.O.A.C., he became their first service engineering director.

Capt. Walker.

Capt. Walker left B.O.A.C. in 1941 to join de Havillands Company and until March 1947 was production manager at Leavesden, where Mosquitoes were turned out in large numbers. For the next five years he was the D.H. representative in the Middle East; then he returned to Hatfield and was liaison officer between the company and Short Bros. on Comet 2 production until his appointment as deputy to the production director.

P.F.F. Ball

THE higher the standard set the more difficult it is to maintain, yet the Pathfinders did it again last Saturday when their annual Ball at the Dorchester Hotel, London, proved to be every bit as enjoyable as in previous years. Nowhere is there to be found a jollier crowd than the men of the P.F.F. and their guests who pack the big ballroom to capacity each year. Although it was a completely informal occasion, Marshal of the Royal Air Force Sir Arthur Harris was nevertheless induced to stand up and say a few words of greeting in response to repeated calls for him. Seated near him and Lady Harris were A. V-M. and Mrs. Don Bennett; and, at tables around, Doc MacGowan and founder members and stalwarts of the Pathfinder Association. Other guests included Air Chief Marshal Sir Frederick Bowhill, Sir James Barnes, Air Marshal Sir Dermot Boyle, A.V-M. H. A. Constantine, A.V-M. W. J. Seward, S/L. Neville Duke and Lt-Cdr. "Mike" Lithgow. As is becoming the custom, the Christmas pudding was led in by a carol-singing choir. The band and cabaret turns were first class. Congratulations for another year to F/L. Alex Thorne, who was largely responsible for the arrangements.



***SAPPHIRE SEVEN:** A "dry" rating of 10,200 lb static thrust—the highest yet announced for any British or foreign type-tested turbojet—has just been disclosed for the Armstrong Siddeley Sapphire 7. Further details will be found in a paragraph above.*

T.C.A.'s flagship, first of 83 Viscounts now ordered for service in North America, is pictured on a final pre-delivery test flight. Of T.C.A.'s decision to buy Viscounts, Mr. Gordon McGregor has said that two years ago they "thought and hoped it was right . . . now we are sure."

VISCOUNTS FOR NORTH AMERICA

Capital's Order Increased: T.C.A.'s Choice Explained

ONLY six months ago Capital Airlines became the first United States operator to buy British airliners for use on scheduled routes in America. The initial order—for three Viscounts—was a modest one, but the contract included an option on 37 more. In August Capital took up this option and announced a fresh one for 20 more Viscounts.

Now comes the welcome news—released in Washington last week—that Capital Airlines have exercised this option for the 20 additional Viscounts. Their total order is more than twice as large as that of B.E.A., Vickers-Armstrongs' next largest Viscount customer, and—a remarkable measure of the airline's belief in this turboprop airliner—the order has been placed without any first-hand operating experience of the type.

Capital's first three Viscounts, machines originally intended for delivery to B.E.A., will be delivered in the spring of 1955. The first 40 are to be delivered by August 1956, and the remaining 20, to complete a standardized fleet of 60, by February 1957.

The number of Viscounts firmly ordered has now reached 177; of these, 40 had been delivered by December 1st and two more awaited delivery. The bulk of Viscount production is at Hurn, near Bournemouth, where the two main assembly shops are being doubled in size. Next year Hurn is scheduled to build 55 Viscounts, and the planned output for 1956 is 98 aircraft. Vickers-Armstrongs say that production can then be increased to meet any further demand for Viscounts, and that delivery dates will remain at a maximum of 24-26 months after contract signature. Regarding further orders, optimism seems well justified; the manufacturers, however, confine themselves to the restrained remark that "Negotiations now taking place will, it is hoped, lead to the further sale of Viscounts overseas." Options already exist for nine aircraft additional to the 177 firmly ordered.

Apart from its tremendous contribution to the prestige and morale of the British aircraft industry, the Viscount now ranks as a major factor in the national economy—as the following figures show.

Dollar value of Viscount export orders:—

Capital Airlines (60)	$67.0m
T.C.A. and Canadian Department of Transport (23)	$17.8m
Total (including provisions for spares)	$84.8m

Throughout the period of peak-rate delivery, the value of Viscount exports to North America will amount to some $5m monthly, or some 8 per cent of current British exports to the American and Canadian dollar markets.

The effect of these Viscount sales is to put British aircraft and associated equipment into fourth place in the list of dollar-earning commodities, the other three being cars, whisky and woollen goods. The Capital order is, incidentally, the largest post-war dollar order placed with a British company, the second largest being T.C.A.'s order.

The sterling value of all Viscount export orders is £40m—representing nearly a quarter of the aircraft industry's share of British world exports between January 1952 and October 1954.

The merits of the Viscount are emphasized clearly enough by the fact that 19 operators in 14 different countries have chosen it. There is, however, special significance in the two big orders placed by airlines on the North American continent. These orders were won in the face of keen competition from U.S. manufacturers strongly placed in terms of earlier successes, experience in design and production, and closer contact with the operators concerned.

In a recent lecture before the Society of Automotive Engineers in New York, Mr. Gordon R. McGregor, president of Trans-Canada Air Lines, set out the reasons for his company's decision to buy 22 Viscounts. The following extracts form an apt post-script to the new Capital purchase reported above:—

"Even in 1951 it was well appreciated . . . that there would be a definite requirement for an aircraft to be used on all T.C.A.'s North American routes, other than the long haul trans-continentals. The operations studies which followed eventually narrowed the aircraft choice for the short and medium range pattern involved to TWO, a well known American piston-engined twin of modern design, and the four turbo-propeller engined Vickers Viscount . . .

"On the one hand, the U.S. contender would be equipped with—for want of a better word—gadgetry with which we were familiar, and knew to be good. Again, geographical proximity between the manufacturer and the purchaser promised a close liaison during manufacture, and reasonably sure availability of parts thereafter.

"On the other hand, the British candidate would be powered by Rolls-Royce, a company which we knew and very much respected, after—at that time—nearly five years of operation of their Merlin engines. Furthermore, to our pleased surprise, we found that the Vickers Company was quite willing to meet our every request for modification of design, which was to produce a completely new cockpit, redesigned fuel system and completely new cabin interior, including heating and pressurization.

"The final decision was therefore taken early in 1952, primarily on the following grounds:—

(1) That since the failure of one of an aircraft's engines during take-off or in flight is still not entirely unknown, it is better under those circumstances to lose 25 per cent of the total power in use than 50 per cent. It will be argued, particularly by certain sales engineers, that four engines are twice as apt to fail as two—but happily experience does not support that argument. It can, however, be well argued that four engines cannot be as cheaply maintained as two of equivalent total power.

(2) The second reason in support of our final choice was our belief that the relative cabin quietness and freedom from vibration of the turbo-propeller engine over the piston engine would produce superior passenger appeal.

"In case there should be any doubts on this point, I would like to stress that no considerations of national background, trade balances or other factors not directly connected with the airline's equipment needs entered into this decision."

Of the Rolls-Royce Dart, Mr. McGregor said:—

"The engine that will be in our aircraft is rated at 1,400 shaft horsepower, a modification with 1,550 horsepower is now in being, and as a development of this basic engine type, 2,000 horsepower is confidently predicted by the Rolls-Royce company, which is notoriously conservative in the matter of such prophecies.

"Our cost calculations in the selection study were based on a service life between overhauls of *600 hours*. British European Airways and Air France are now certified to operate the engine for *1,050 hours* between overhauls and B.E.A. have a type test under way for a 1,200 hour interval between scheduled engine removals. T.C.A. will commence operations on the basis of *750 hours* which gives us a 25 per cent improvement over our original calculations.

Mr. McGregor went on to discuss requirements for airliners:—

"T.C.A. believes that not a great deal more development work will be done on piston engine types, and that the years to come will see very large numbers of turbo-propeller engines used in civilian aircraft, with maximum designed speeds not exceeding 450 m.p.h. We in T.C.A. think that civil aircraft designed for air speeds between 450 and 550 m.p.h. will be powered with by-pass engines, a type so far as I know, not yet in use in either military or civil aircraft. We think that the use of full jet engines will be confined to aircraft with designed speeds in excess of 550 m.p.h. and probably only used economically over the longer route.

"It seems quite sure that civil aircraft built in this country will be powered by British turbo-propeller engines in the not too distant future, and I for one would say—WHY NOT?"

***BIG TWIN**, by Piasecki of Pennsylvania — the largest rotary-wing aircraft in the world. This XH-16 prototype will be joined in the new year by the YH-16A, powered by a pair of Allison YT38 turbines, which, owing to their increased power and lighter weight, should confer an all-round improvement in performance. The overall length of both aircraft (rotors turning) is 134ft.*

HERE AND THERE

Royal Lecturer

NEXT Thursday, December 16th, the tenth British Commonwealth and Empire Lecture of the Royal Aeronautical Society is to be delivered by H.R.H. the Duke of Edinburgh. At the time of our going to press the R.Ae.S. had not disclosed the subject of the lecture.

Rolls-Royce Releases

THE existence may now be disclosed of a Rolls-Royce Avon designated RA.18 and of a Conway known as the RCo.5. A Soar, designated RSr.1 and rated at 1,760 lb thrust (the RSr.2 is rated at 1,860 lb) may also be named.

Restitution

IN fulfilment of their recent agreement, the Government of Communist China have paid compensation for the Cathay Pacific Airlines DC-4 shot down off Hainan Island on July 23rd. Last week they delivered a cheque for £367,000—the amount of the claim—to the British Chargé d'Affaires in Peking.

M.o.S. Appointments

THE Ministry of Supply announces that Dr. A. G. Touch has been appointed Director of Electronics Research and Development in succession to A. Cdre. W. G. Pretty. Forty-three years of age, he has been Deputy Director, Electronics Research and Development (Air) since 1952. A. Cdre. C. A. Bell will fill the post thus made vacant. Deputy Director of Communication Development (now D.L.R.D.) from 1946-1948, he is at present S.A.S.O., No. 90 Group, Royal Air Force.

***LITTLE SINGLE**: Weighing about 400 lb, this one-man helicopter is powered by what is described as a "two-cycle standard water-cooled engine." Capable of some 60 knots, the craft has been developed for the Goodyear Aircraft Corporation of America by Mr. Paul Ziegler, seen demonstrating it to the U.S. forces.*

Air Attaché Promoted

IT has been announced that the Italian Air Attaché in London, Col. C. F. de Porto, has been promoted to the rank of general. Commissioned in the Italian Air Force in 1931, he succeeded Col. D. S. Fanali as Air Attaché in the summer of 1951. It is not expected that Gen. de Porto will be relinquishing his post for the time being.

Cargo Rotodyne

SPEAKING at his company's recent annual general meeting, Sir Richard Fairey mentioned an order for a second Rotodyne with "somewhat different internal arrangements". This week the Minister of Supply said that the fuselage of this second Rotodyne would be "of a size approximating to the requirements of civil operators for a cargo helicopter".

Pleasant Sunday Afternoon

A METEOR pilot of No. 604 Squadron, R.Aux.A.F., had a lucky escape after baling out at 20,000ft over the Thames Estuary when his aircraft had got into a spin (from which, reportedly, it would not recover) near Southend last Sunday. The pilot—P/O. Brian Cross—used his ejector seat successfully, then found himself with a torn parachute; he believed the canopy was ripped by parts of the aircraft which broke away. Although the parachute collapsed three times during the descent, Cross suffered nothing worse than a suspected fractured ankle when he alighted in four feet of water. He took to his rubber dinghy and within twenty minutes was picked up by a Grumman Albatross from the U.S.A.F. Air/Sea Rescue Unit at Manston.

Colombo Air Race

INDIA, Pakistan, Burma and other South-East Asian countries are being invited to participate in a 200-mile air race at Colombo early next year; the event is being held in conjunction with a flying display organized by the Air Academy of Ceylon.

Airmail Greetings

READERS airmailing Christmas cards abroad may be glad of the reminder that unsealed cards are carried at the reduced second-class rates of 5d, 6d and 7d as compared with the normal first-class rates of (according to distance) 9d, 1s 3d and 1s 6d respectively.

Rotor Parade-Ground

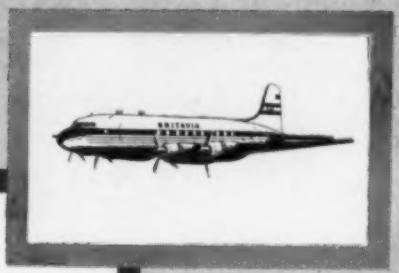
TO be known as Felker Heliport, a U.S. Army helicopter training ground was officially opened at Fort Eustis, Virginia, last Tuesday. To be used for tactical, logistical and mechanical experiments as well as for training, the ground has two 600-foot runways in the form of a cross, the extremities of which are linked by a circular taxi track. There are eight circular landing areas round the outer perimeter.

Ambulance on the Way

NOW on his way to Queensland with a D.H. Rapide for the Cairns Branch of the Queensland Ambulance Transport Brigade is Capt. F. G. Roche, who is accompanied by his wife, herself a qualified pilot. They took delivery of the aircraft—ex-Cambrian Air Services G-AGSI—from W. S. Shackleton, Ltd., who had had it converted to a Mk 4, with constant-speed airscrews, engine-driven generators and special radio.

Another Radar Chain

A STATEMENT has been issued in Ottawa and Washington to the effect that the U.S.A. will build and pay for a radar warning chain "above the Arctic Circle" and across the wastes of Northern Canada. Unofficial estimates have put the cost as high as £357 million. Who shall pay for operation of the system when it is completed has not yet been settled. It is understood that seven radar stations in the U.S. sector of the line are already operating near the Barter Islands, along the north coast of Alaska. Eventually the line will extend for about 3,000 miles, probably ending in Greenland.



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26th November, 1954.

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Yours sincerely,

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THE SUPERSONIC FIGHTER

PART I

By J. W. FOZARD, D.C.Ae., B.Sc. (Hons), Grad. R.Ae.S.

IN this important article—to appear in three sections—Mr. Fozard reviews the probable performance characteristics of the true supersonic fighter of the near future, and examines some of the problems that will face its designer. His analysis will, we believe, constitute the most thorough treatment of the subject yet published, giving as it does a clear picture of the line of development which fighter design is likely to follow in the next few years. Mr. Fozard is a project engineer with Hawker Aircraft, Ltd., designers and constructors of the Hunter. He entered the industry in 1943, undertaking a five-year engineering apprenticeship with Blackburn Aircraft. This included two years at Hull Technical College, where he obtained his degree. He next took the post-graduate course at the College of Aeronautics, obtaining a diploma with distinction in aircraft design; from there he went to Hawkers. For the past two years he has been a member of the aerodynamics committee of the Royal Aeronautical Society.

IN order to obtain a clearer understanding of the problems involved in designing for supersonic flight it is first necessary briefly to survey the sequence of events which has led us to the state of the Art as it exists today.

1.0 Introduction

The so-called "sonic barrier" and the phenomena of supersonic flow are the physical manifestations of the compressibility of the atmosphere. These compressibility effects were first experienced in flight during the 1939-45 war. Early in this period certain fighter aircraft, notably the Spitfire and the Lightning, were subjected during the course of steep dives from high altitude to novel and unpleasant phenomena such as intense buffeting and control ineffectiveness. These effects resulted from the fact that, whilst the aircraft was travelling at a speed well below the speed of sound, its shape was such that the airflow, in traversing the contour of the aircraft, was accelerated to speeds greater than the local speed of sound—a condition resulting in the formation of shock-waves.

A shock-wave is a compression wave of finite amplitude (as opposed to a *sound* wave, which is of infinitesimally small amplitude) and it occurs in nature as a surface of discontinuity between a region of low pressure (in front of the wave) and a region of high pressure (behind the wave). The blast-wave from an explosion is an example of a very intense shock-wave. In supersonic and transonic aerodynamics, where the shock-wave is at rest relative to the body being considered, it is more commonly regarded as a mechanism whereby the velocity of the airstream is changed—velocity here implying direction as well as speed. When a supersonic airstream encounters a shock-wave the component of the stream velocity *normal* to the wave is always reduced from supersonic to subsonic. This change of velocity, which for a normal shock-wave may be as much as several hundred feet per second, takes place through the thickness of the wave, which is of the order of 0.0001in. During this very rapid compression process there is a degradation of mechanical energy into heat energy, and the air downstream of the wave is thus at a relatively higher static pressure and temperature than the air in front of the wave. The energy which is converted to heat is irrecoverable; thus, from a practical point of view, the shock-wave can be regarded as an energy sink. If the flow pattern about a shock-wave is to be maintained in a steady state, additional mechanical energy must be supplied equal to that which is being converted to heat.

This particular property of shock-waves is of vital importance to the aircraft designer, for it means that when a shock-wave is formed on the surface of an aircraft additional energy must be supplied to maintain the existence of the wave. In practice the presence of the wave is always revealed by an increase in the drag of the machine; and, if steady flight is to be maintained, the mechanical energy drained away by the shock-wave must be replaced by an increase in the engine thrust. The additional drag due to the presence of the shock-wave is known as the wave drag, and this wave drag has been and will continue to be the major obstacle in the way of sustained supersonic flight.

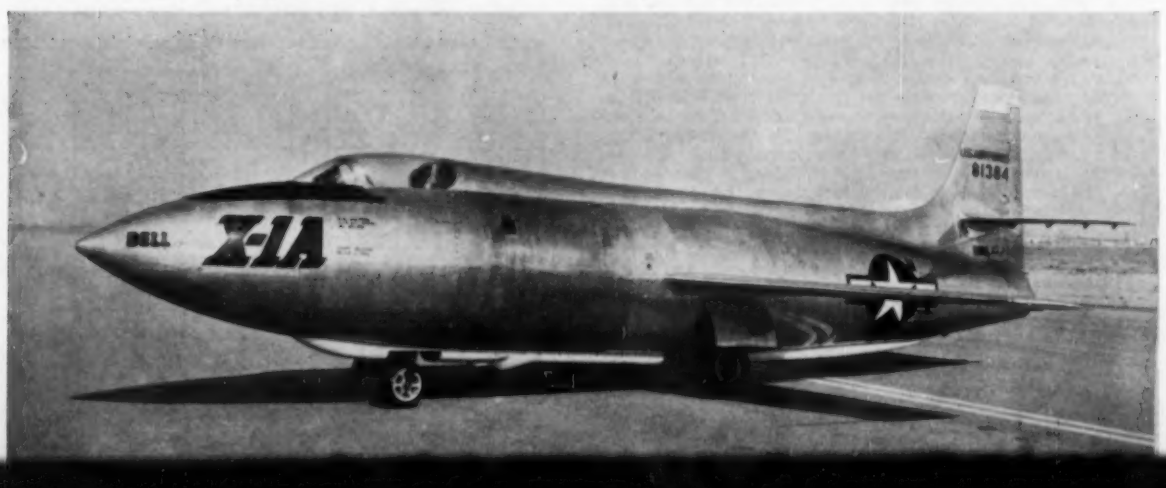
Almost all the now familiar compressibility effects can be explained in terms of shock-waves. The discontinuous rise of pressure through a shock-wave on an aircraft means that changes will occur in the lift and other forces and moments acting on the machine. The interaction of the shock-waves with the boundary layer often causes separation to occur, thus giving rise to such phenomena as loss of lift and wing-dropping. If the point of separation oscillates fore-and-aft over the contour of the aircraft, violent buffeting can occur, due to the rapidly varying areas over which the high pressure behind the wave is acting. The occurrence of a shock-wave at or near the hinge line of a control surface will prevent the passage upstream of changes of pressure due to a change of control angle and thus will cause a decrease in control effectiveness. In conjunction with this effect the local increase of pressure behind the wave will act on the surface of the control and increase its hinge moment. This is the heavy-and-ineffective-control phenomenon, so familiar to pilots of the less advanced high-subsonic-speed type of aircraft.

At the time these phenomena were somewhat alarming and, although their fundamental cause was known, the actual mechanics of the process were but slightly understood. It was the introduction of the gas turbine powerplant which emphasized the need for further investigation in order to obtain a better understanding of these compressibility effects. The vastly increased power offered by this new form of propulsion so much enhanced aircraft performance that the shock phenomena were encountered not only in dives but also in normal level flight.

On the early jet-propelled aeroplanes the most critical problems were those of control and stability at high speed, and by far the larger proportion of the research carried out was directed into this field. Information and knowledge were gradually acquired and it was only when this particular aspect had been mastered sufficiently to permit safe flight at all speeds that the magnitude of the major problem—the drag rise—became apparent. At speeds just beyond the critical Mach number (i.e., the Mach number at which the flow over the contour of the aircraft first reaches sonic speed and thus initiates the shock-waves) the shock system around these early jet-propelled aeroplanes had developed to an intensity such that the rate of change of drag with speed was, for all practical purposes, infinite. This extremely steep drag-rise meant that, in terms of Mach number, there was a fixed upper limit to the speed which the aircraft would attain, regardless of altitude or of any extra thrust which could be provided, either by fitting more powerful engines or by using the weight of the machine as thrust, by diving.

The Germans were the first to put to practical use the device of sweepback to delay the onset of compressibility effects and reduce their severity. The use of sweepback compels the isobars (lines of constant aerodynamic pressure) to lie along the sweep of the wing in a direction inclined to the line of flight. A shock-wave is formed when the air velocity normal to the isobars first

"Historically the first manned aircraft to exceed the speed of sound in level flight was the Bell XS-1. . . ." Shown is the similar, but later, X-1A.



reaches sonic speed. For this critical condition, it can be seen that the free stream velocity (i.e., the speed of the aircraft) will be greater when the isobars are swept than when the isobars are normal to the line of flight. In this way the employment of sweepback will postpone the critical Mach number of a wing.

The shock-wave, when it does appear, is also compelled by the sweepback to lie in a direction inclined to the line of flight, parallel to the isobars. Since, as we have already noted, only that component of velocity *normal* to a shock-wave is reduced from supersonic to subsonic speed in traversing the wave, it follows, for the wave formed on a swept wing, that only the component of the free-stream velocity which is normal to the isobars will be affected by the shock. This velocity component is a function of the angle of sweep of the isobars, and the greater the sweepback that can be impressed on them by the geometry of the wing, the smaller will be the component of the free-stream velocity affected by the shock-wave and thus the smaller will be the energy losses. Thus sweepback will suppress the drag-rise, since at any particular speed the shock-wave present on a swept wing will be less intense than the shock carried by an unswept wing of the same thickness/chord ratio at the same speed and incidence.

When the results of German research and flight experience became available at the end of the war, fighter performance was substantially enhanced. In this country the de Havilland 108, the Hawker P.1052 and the Supermarine 510, moderate though their sweepback was by present standards, each showed a considerable performance edge over the straight-wing fighters which at that time were in service or under development.

The Americans and the Russians likewise were not slow in realizing the advantages of sweepback; the F.86A and the early Mig-15 were flying contemporarily with the British machines mentioned above. Unfortunately the prevailing economic situation prevented these British swept-wing prototypes from being immediately developed as production fighters. The policy of make-do-and-wait did, however, give a respite during which the information and experience gained on these first British swept-wing aircraft could be digested and properly evaluated. This experience was subsequently embodied in later designs such as the Hunter which are now entering service with the R.A.F.

Historically the first manned aircraft to exceed the speed of sound in level flight was the Bell XS-1, on October 14th, 1947. This rocket-powered research aircraft, however, is far removed both in time and type from present-day operational type transonic fighters such as the English Electric P.1 and the North American F-100. These aircraft are the true "firsts" of the supersonic era but in turn even these machines are but the forebears of the supersonic fighter proper—the aircraft which is now nearer to us in time than the original first supersonic flight of the XS-1.

2.0 Scope

It is the purpose of this paper to discuss some of the problems which the aircraft designer—in particular the designer of the fighter aircraft—must face in creating a machine capable of sustained flight at supersonic speeds. To avoid confusion it is essential first of all to define the type of aeroplane which will be the subject of the discussion.

It is fortunate that in this matter it is possible to define its performance by the type of drag curve which an aircraft possesses. Fig. 1A shows the drag curve exhibited by the straight-wing type of subsonic jet fighter. The steepness of the drag-rise is such that the maximum Mach number is almost constant irrespective of the amount of thrust. The swept-wing subsonic fighter shows the type of drag curve given in Fig. 1B. The use of sweepback has delayed and suppressed the drag-rise sufficiently to permit supersonic speeds in a dive, but the maximum speed in level flight remains subsonic.

The types of aircraft which are capable of sustained supersonic speeds in level flight can be placed in two distinct categories:—

(i) *The transonic aircraft.* It is to this class that the first generation of supersonic machines belong. By the use of greater sweepback and lower t/c ratios than the subsonic aircraft the drag-rise has been suppressed, sufficient in this case to permit level flight speeds in excess of the speed of sound. The drag curve common to this type of aircraft is shown in Fig. 1C. An engine compatible with this class of airframe shows only a small excess of thrust over the drag at low supersonic speeds, with consequent poor manœuvrability. The defining characteristic of this class of fighter is that the top speed in level flight is in the transonic region, i.e., less than a Mach number of approximately 1.5.

(ii) *The supersonic fighter proper.* It is this particular class of aircraft which is the subject of this paper. As a type, the supersonic fighter may be regarded as the transonic fighter in its full maturity, and it is defined by the characteristic drag curve shown in Fig. 1D. Note that the transonic drag-rise is markedly shallow, thus permitting the thrust curve to run on parallel to the drag until the effects of falling intake efficiency at high supersonic speeds finally cause the thrust curve to invert and intersect the drag curve. The speed range of this, the true supersonic aircraft, may be up to approximately M = 2.75 to 3.0 where propulsion is by turbine engines; but when ramjet powerplants come into common use this range may extend to speeds up to approximately M = 4.0. This paper will discuss in detail some of the problems which must be overcome in the design of such a supersonic fighter, and will proceed to show how the thrust and drag curves characteristic of such an aircraft affect the performance of the machine.

3.0 The Problems

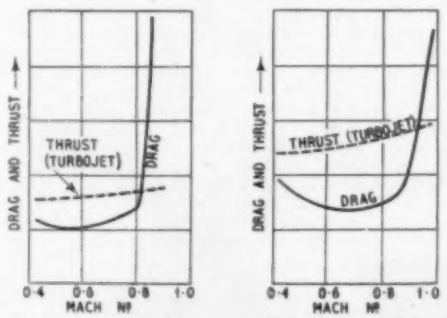
Before proceeding to a full discussion of the effect of some of the many design parameters on the evolution of an aircraft capable of sustained supersonic speed, the specific problems which confront the designer will be enumerated in logical order.

(i) *Drag and Thrust.* At speeds beyond the critical Mach number the most significant contribution to the drag of an aircraft results from the system of shock-waves surrounding the machine. The skill and knowledge of the designer must be exercised to the utmost in shaping the aircraft so that the formation of the waves is postponed to the highest possible Mach number, and so that their intensity is reduced to give the minimum subsequent drag-rise. This reduction of wave drag is the first and the most vitally important step along the path to sustained supersonic flight.

In conjunction with this process of aerodynamic refinement, the designer must select an engine which, when fitted to the airframe, will deliver sufficient thrust to propel the combination as economically as possible up to and at the design speed.

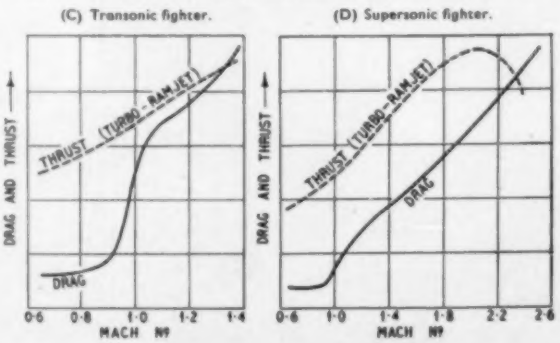
(ii) *Control and Stability.* The provision of effective controls is of paramount importance if full use is to be made of the manœuvring potential of the supersonic aircraft. In addition, the aircraft must possess adequate stability margins so that its efficiency as a weapon (i.e., as a gun- or bomb-platform) is not impaired. On the true supersonic fighter these problems are especially difficult because of the very large speed range which the aircraft can cover. Due to the fundamentally different character of subsonic and supersonic airstreams the successful evolution of a particular control (and its associated artificial feel system) that will be entirely satisfactory at speeds as far apart as M = 0.2 and M = 2.2 will present the designer with problems of unprecedented difficulty. On questions of stability, particularly the stability of the asymmetric motions, the difficulties seem insuperable and many designers are convinced that adequate stability will be obtained only by resorting to artificial stabilization.

(iii) *Aerodynamic Heating.* This problem is not new, nor is it peculiar to supersonic flight. The temperature-rise experienced in a moving fluid is, however, proportional to the square of the speed, so the phenomenon becomes important only at very high speeds. It so happens that for bodies moving in air



(A) Unswept subsonic fighter. (B) Swept subsonic fighter.

Fig. 1. Characteristic drag curves (level flight near tropopause).



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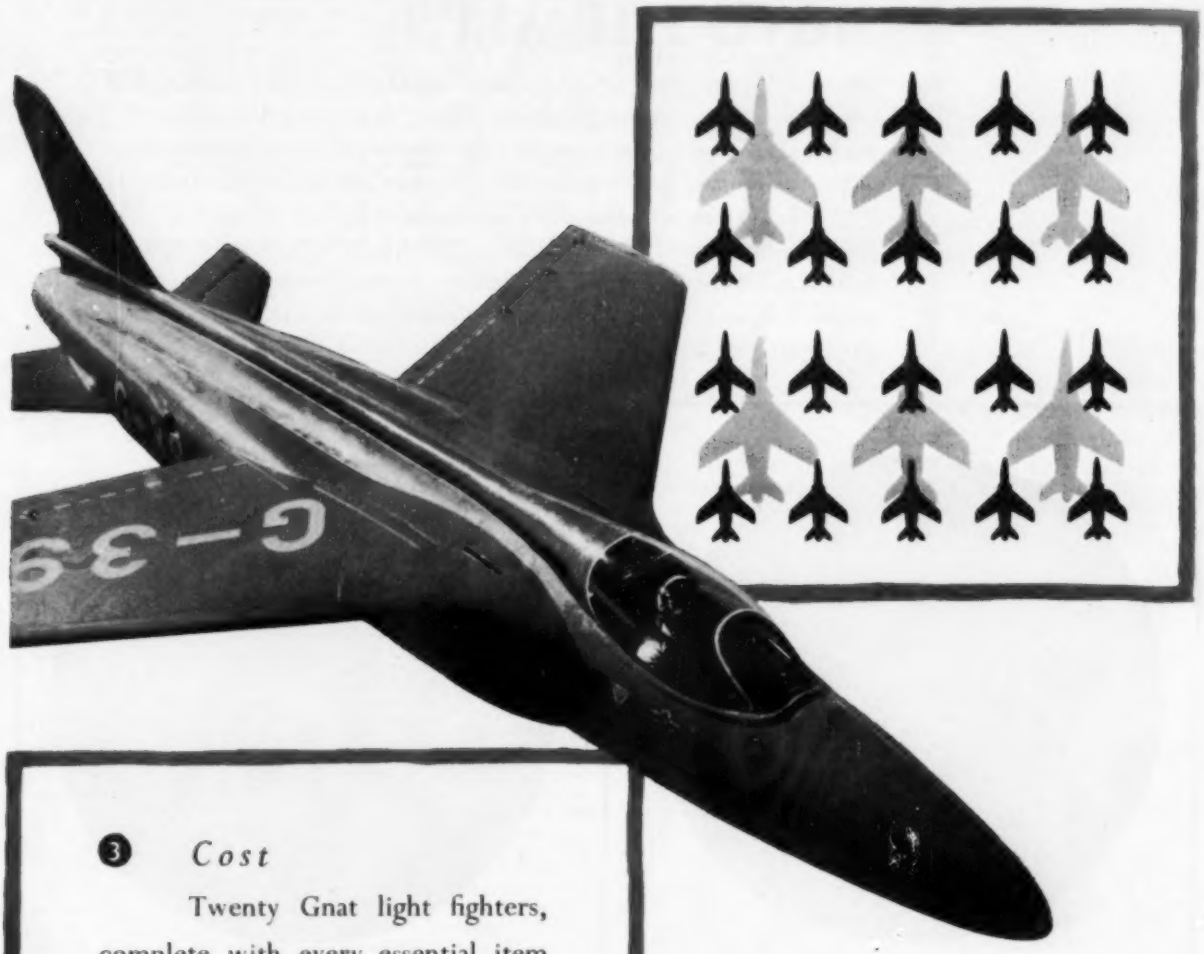

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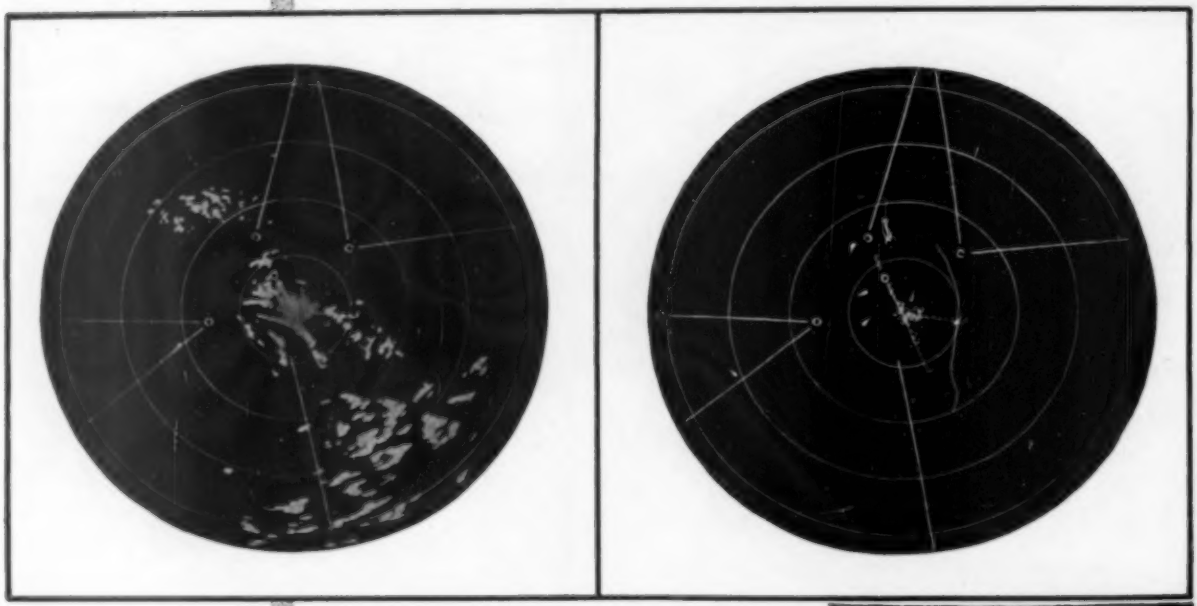
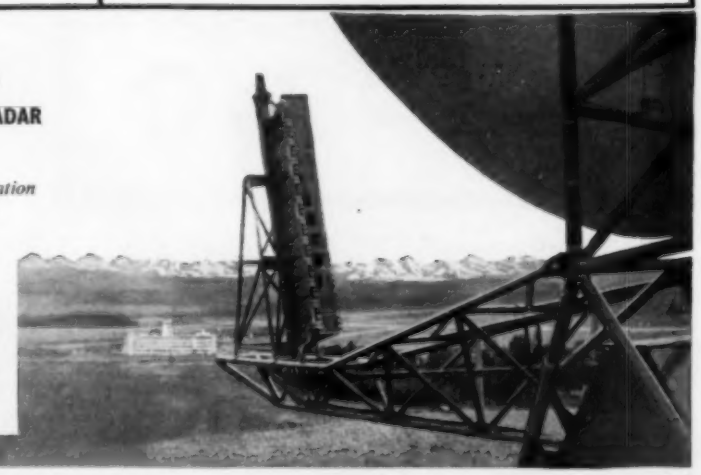


COSSOR AIRFIELD SURVEILLANCE RADAR (ACR Mk. VI)

A view of the installation at Zurich Airport.



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THE SUPERSONIC FIGHTER . . .

these high speeds cannot be divorced from high Mach numbers, and aerodynamic heating becomes yet another problem for the designer of the supersonic fighter. The chief effects of this phenomenon on aircraft design will be remarked in the introduction of different materials and new methods of construction rather than in changes in the shape of the aeroplane. It is likely to affect the performance of the supersonic aircraft only by virtue of the weight increase (due to refrigeration, insulation, and the replacement of aluminium alloys by steel and titanium) which will be entailed in combating the effects of high temperatures on the structure and equipment.

A full discussion of the effects of these three basic problems on the design of the supersonic type of aircraft is beyond the scope of any one writer. The present article will consequently be confined to the first and the most important problem: the reduction of drag and the choice of powerplant. This aspect will be treated in as much detail as can be permitted by present circumstances, and the concluding section will show how the performance of the supersonic fighter is critically dependent on the degree of success realized by the designer in his attempts to achieve low drag and high thrust.

4.0 Reduction of Drag

It has been noted that in this matter of drag reduction the objectives of the designer are twofold: first the postponement of the critical Mach number and second the suppression of the increase of drag with further increase of Mach number beyond the critical value. Since the largest single component of drag in the transonic and supersonic regimes is the wave drag, the art of drag reduction is concerned almost entirely with arranging the geometry of the aircraft so that the intensity of the enveloping shock system is at a minimum.

4.1 Wings. The wave drag of a wing is influenced chiefly by two parameters; (i) the sweepback of the wing plan-form, and (ii) the section thickness/chord ratio. The effect of these two parameters on the designer's first objective—the postponement of the critical Mach number—is shown in Fig. 2. The value of M_{crit} given by this figure is that for the wing alone; when the wing is combined with a fuselage the M · of the combination will be less than that of either of the components alone, due to their mutual interference.

The effect of increasing sweepback on the wave drag of three wings each of 5 per cent t/c ratio is shown in Fig. 3. The principal effects of sweepback as shown in Fig. 3 are (i) postponement of M_{crit}, (ii) reduction of the slope of the drag-rise (the slopes shown are in the ratio 1:0.5 :0.2 for 0 deg, 30 deg and 45 deg sweep respectively) and (iii) a reduction of the peak drag coefficient and a simultaneous shift into the supersonic range.

At Mach numbers in excess of approximately M=2.0 there is little to choose between the three plan-forms from the point of view of wave drag alone, and for an aircraft intended to operate only at speeds of this order and above, the choice of wing plan-form will be eased by the elimination of sweepback as one of the variables. It must be admitted that from many aspects the adoption of an unswept wing is very attractive but, it must be emphasized, *only if the aircraft is intended to operate at speeds in excess of M=2.0* If an aircraft is required to operate efficiently at any point within a speed range extending from M=0.9 to M=2.0+, then the overwhelming superiority of the swept wing at transonic speeds will enforce the adoption of this plan-form. Further to emphasize this aspect it must be pointed out that when the three wings of Fig. 3 are each combined with the same fuselage, then at transonic speeds the margin by which the wave drag of the unswept wing plus fuselage combination exceeds the wave drag of the swept wing plus fuselage combination will be very much greater than the margins shown on Fig. 3 for the wings alone. This is due to the notoriously bad interference between the two components of the unswept wing plus fuselage combination at speeds near M=1.0.

With current progress towards very thin wings, however, the degree of sweepback required in the supersonic fighter will be fairly modest by comparison with that of the transonic fighters of the present day.

Reference already has been made above to the effect of the section thickness/chord ratio on the Wing M_{crit}. It is, however, at supersonic speeds (beyond the transonic region) that the section t/c ratio assumes its major importance as a means of reducing the wing drag. At these speeds the wing wave-drag is proportional approximately to the square of the section t/c ratio. This means that if the t/c ratio of a particular wing plan-form can be halved, the wave drag of the wing will be reduced by approximately 75 per cent. Aside from questions of sweepback (which factor determines the Mach number at which the peak wave-drag coefficient occurs) the dependence of the wing wave-drag on the *square* of the t/c ratio is the principal reason for the thin wing. On current operational fighters wing t/c ratios are of

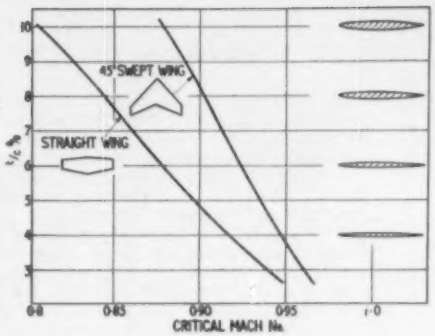
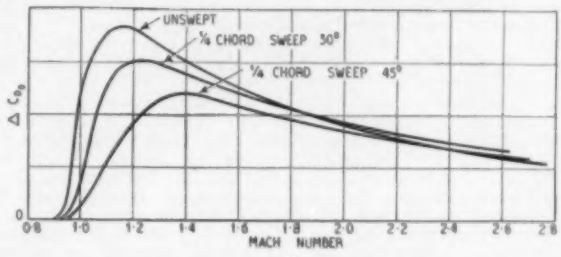


Fig. 2. Effect of variation in t/c and sweepback on wing M_{crit}.

Fig. 3. Effect of sweepback on the zero-lift wave-drag coefficient (based on gross wing area) of a typical fighter wing. For each wing: taper ratio, 4.5 to 1 (0.225); aspect ratio, 3.0; t/c 5.0 per cent.



the order of 9 per cent to 12 per cent, and on fighters now entering service or under development wing t/c ratio varies between about 6 per cent to 9 per cent. The next generation of fighters (the true supersonic machines) will have wing t/c ratios which lie between 3 per cent and 6 per cent. Such extremely thin wings are essential if drag of the aircraft is to be reduced sufficiently to permit sustained flight at high supersonic speed. The formidable aerodynamic, structural and manfacturing difficulties implicit in such wings, particularly if in addition there is more than a token amount of sweepback, are unlikely to permit for a number of years the development of a supersonic wing which is entirely satisfactory from all aspects.

The substance of the above remarks on wing wave-drag applies also to the other flying surfaces—the fin and the tailplane. These components, being primarily controls, are, of course, subject to other requirements which may over-ride the aerodynamic refinements essential for low wave-drag. None the less, within the limits imposed by the special functions of the component, the designer must, by the means indicated above, seek to minimize their contribution to the total drag of the aircraft.

4.2 Bodies. Reduction of the wave drag of the fuselage and of the other non-lifting components of the aircraft, such as the cabin hood, nacelles, etc., is achieved by applying the same basic measures as for reducing the wing wave-drag i.e. the avoidance of normal shock-waves and reduction of the effective diameter-to-length ratio. For these non-lifting components, however, the device of sweepback has no physical significance, and the diameter/length ratio (corresponding very roughly with the t/c ratio of a wing), in conjunction with the surface slope of the body profile, determines the magnitude of the wave drag coefficient. In seeking to minimize the body wave-drag it is not enough merely to strive for the lowest possible diameter/length ratio, as the actual shape of the body is also of very considerable importance. To avoid a detached normal shock-wave (with its consequent very high drag penalty) the nose of the body should be sharp-pointed or, if a nose air-intake is used, the intake lip radius should be as small as possible consistent with maintaining adequate intake efficiency under the critical conditions of low forward speed and high engine r.p.m. The cone angle at the nose of the body is of particular importance as the wave drag of this section is proportional approximately to the square of this angle. Whilst it is desirable for this reason to have a relatively long finely-tapering front fuselage, other considerations—such as stowage space, pilot view and efficient transmission of radar pulses —tend to limit the degree of fineness which can be achieved in practice.

The jet nozzle at the rear of a fuselage or nacelle must be as nearly as possible equal in diameter to the end of the body. At supersonic speed the air will expand round the end of the body, this expansion resulting in a local reduction of pressure which acts as a rearward suction force on the base of the fuselage. This base drag (as it is termed) can be minimized only by reducing the annular area on which the base suction acts.

Due to the vital necessity to reduce wave-drag, the shape of the cockpit canopy is likely to suffer extensive changes on the true supersonic fighter. The angle of the windscreen relative to the fuselage axis must be kept small as the windscreen wave-drag is proportional to the square of this angle. The rear portion of the canopy must also have fine taper, and the overall size of the

THE SUPERSONIC FIGHTER . . .

cabin hood must be a minimum. All these requirements conflict with the provision of a clear all-round field of view for the pilot. Unfortunately, however, the drag penalty incurred by fitting to a supersonic fighter what at present is regarded as a normal size and shape of canopy may be as high as 15 per cent of the total aircraft drag; so that, inevitably, some shrinkage of hood size with the consequent restriction of view *must* be tolerated. On this subject it is worth noting that in the change from piston engine to gas turbine the fighter canopy was much enlarged and the field of view greatly widened. Pilots will not welcome a reversal of this trend, but with skill and ingenuity the designer can reduce the size of the canopy without major sacrifice of the other desirable features. A satisfactory assessment of such changes can be determined only by asking the question: "Do they enhance the overall effectiveness of the aircraft *as a weapon*?" If the answer is in the affirmative then the end justifies the means, for the fighter designer's sole concern is the creation of the best possible weapon.

The further consequences of aerodynamic heating at high supersonic speed will also bring about changes in the shape of the canopy. Glass, with its much better temperature-resisting qualities, will replace the present transparent plastics. Due to the difficulties involved in fabricating optically clear glass panels of complex curvature, the trend will be away from the present "bubble" canopies towards shapes which can more easily incorporate a relatively larger number of individually framed glass panels of shallow curvature. The keen observer already will have noted these changes, taking place on existing aeroplanes. The Douglas Skyray, the Convair F-102 and the Douglas X-3 each has a cockpit canopy that owes its unusual shape to considerations of minimum wave-drag and the effects of aerodynamic heating on transparent plastics.

In his efforts to achieve the minimum wave-drag the designer must not forget that in the brave new world of supersonic flight his older and more familiar demons—viscous drag and induced drag—are still present.

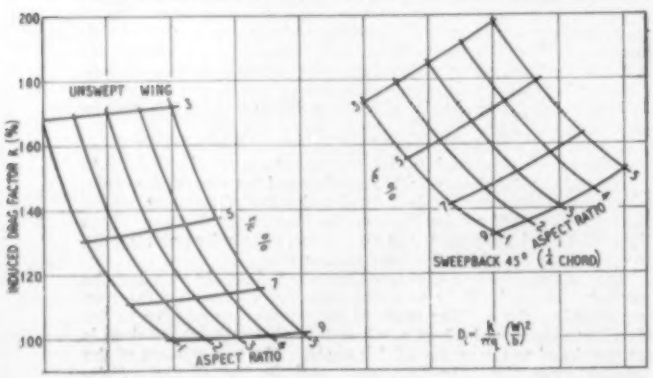
4.3 Viscous drag. The viscous drag (the term viscous here including form drag and skin friction) becomes of major importance when the wave drag has been reduced by virtue of the aerodynamic refinements outlined above. Fortunately the fine lines necessary to achieve low wave-drag are also favourable in promoting low form-drag. The skin friction component can be reduced by maintaining a smooth surface on the machine and by keeping down the "wetted" area to the absolute minimum—"wetted" area including internal ducting in addition to the external surface of the aircraft.

4.4 Induced drag. On the supersonic fighter the induced drag (the drag due to lift) is of particular importance at very high altitude and under high subsonic cruise conditions at medium altitudes. The induced drag D_i is given by the equation

$$D_i = \frac{k}{\pi q}\left(\frac{W}{b}\right)^2 \qquad \text{where } q = \tfrac{1}{2}\rho V^2$$

The variables under the control of the designer are the induced-drag factor k and the span loading $\left(\frac{W}{b}\right)$; the weight of the machine in lb per ft of wing span. The induced-drag factor is a measure of the lifting efficiency of the wing plan-form, and for conventional wings in subsonic flow a value of $k = 1.1$ can be approached with an elliptic spanwise distribution of lift. Unfortunately, both sweepback and low t/c ratio (the necessary adjuncts for low wing wave-drag) have a very marked deleterious effect on k at subsonic speeds. Fig. 4 demonstrates the magnitude of these effects.

Fig. 4. Variation of induced-drag factor at subsonic speeds (relative to value of k for unswept wing with aspect ratio 3.0 and t/c 9.0 per cent).



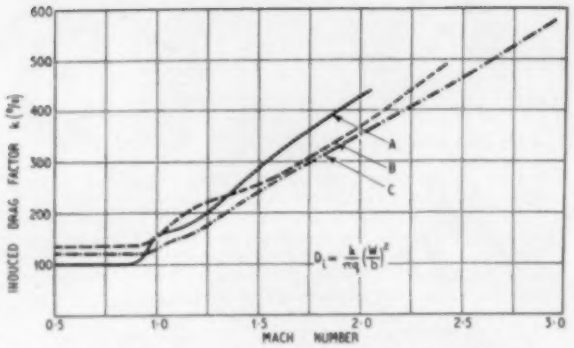


Fig. 5. Induced-drag factor for three typical supersonic fighter wings (relative to value of k for wing A at subsonic speeds).

	¼ chord sweep	aspect ratio	t/c %
Wing A	0	4.0	6.0
Wing B	50°	3.3	7.0
Wing C	30°	3.75	4.0

At speeds beyond $M_{\gamma t}$ the shock-waves interfere with the lift distribution and the induced-drag factor rises markedly with the increase of speed into the supersonic range, where the more rearward inclination of the resultant force vector leads to k increasing steadily as Mach number is increased. This is illustrated by Fig. 5, which shows the variation of k with Mach number for three types of wing plan-form.

It is possible to effect a considerable reduction in the value of k over a particular small supersonic speed range by cambering and/or twisting the wing so as to give more favourable lift-distribution. This, however, usually has the undesirable effect of increasing the value of k at other speeds outside the particular speed band considered. Thus it may be possible, for an aircraft which is intended to operate for long periods at one particular speed—such as a supersonic bomber—to shape the wing so as to effect a very considerable reduction of induced drag. On a fighter, however, which must operate with maximum efficiency over a very wide range of speed, it is normally impossible to effect an overall gain in performance by resorting to such devices.

The wing of the supersonic fighter is evolved primarily from consideration of wave drag, and the designer usually must accept the high values of k associated with such wings. To offset this, his aircraft should be designed so as to have a moderate span loading. The dependence of the induced drag on the square of the span loading attaches particular importance to this parameter, current values of which are of the order 500 lb/ft for aircraft having wing loadings of approximately 50 lb/sq ft. With wing loadings of this order the 1g stall occurs at transonic speeds at extreme altitude (Fig. 17, Pt. III), and if an aircraft is intended to fight (as opposed merely to flying) at low supersonic speeds at such altitudes, it is vital that the span loading should not exceed approximately 600 to 650 lb/ft, otherwise manœuvrability will be marginal under these conditions of flight.

4.5 Trim drag. Under the general heading of induced drag mention must be made of trim drag. The unfavourable changes of pitching moment and the rearward shift of wing centre of pressure which occur during the change from subsonic to supersonic speed lead to large down-loads on the tailplane in level flight and in manœuvres. These loads contribute to the aircraft drag in two ways: (i) the induced drag on the tailplane itself, and (ii) increasing the wing induced drag by virtue of the extra lift the wing must generate in order to balance the trimming down-load on the tailplane. In most conditions of flight the trim drag amounts to only a few per cent of the total aircraft drag, but at very high altitude and at the lower supersonic speeds trim drag becomes a significant factor. Aircraft having a relatively short tail arm, and particularly tailless machines, can be seriously embarrassed by this phenomenon. Moderate span-loading together with a reasonable tail arm considerably reduce the severity of the problem but in addition the designer should avoid configurations which are likely to suffer large pitching moment changes in the transonic region.

The above discussion has considered in some detail the policy which the designer must follow if the drag of the aircraft is to be reduced so as to permit the attainment of high supersonic speeds in level flight. The second part of this article will show how the application of this policy is reflected in the drag characteristics of the supersonic fighter. The characteristics of possible powerplants for the supersonic fighter will also be discussed and consideration given to the various factors which influence the choice of powerplant.

To be continued

GERMANS VISIT THE SERVICES

Parliamentary Delegation Watches Canberra and Hunter Demonstrations

AS briefly recorded last week, a party of German parliamentarians have lately been on a visit to Britain, during which they have been shown various aspects of this country's armed forces, particularly those concerning the control of forces by the normal processes of democratic government. Ostensibly the visitors' object was simply to observe the developments in the armed Services during the period in which they have been out of touch with British military technical progress.

While they were here, they visited Parliament, interviewed those responsible for the direction of H.M. Forces, and were taken to see the Services on duty, particularly the Royal Armoured Corps at Aldershot, the Royal Naval Dockyard, Portsmouth, and two R.A.F. stations.

On November 26th, they visited No. 2 F.T.S. at Hullavington. After their conducted tour of the station they were to have witnessed a flying demonstration by a Provost and a Vampire Trainer, but the seasonable weather precluded all thoughts of flying and the scope of their visit was therefore limited. This was all the more regrettable in view of the fact that they were to have seen a Provost aerobatic performance by F/L. Leggett, who is well known for his efforts in this field.

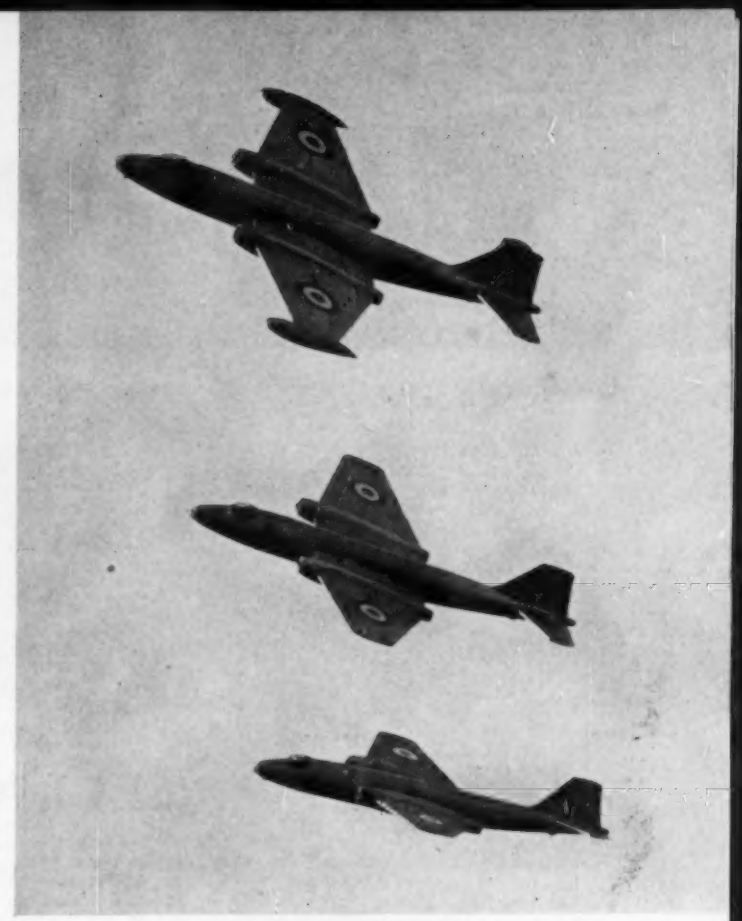
Their next visit to the R.A.F. was to Marham on November 30th; and here, despite high winds and some threatening cloud, the flying programme was carried through. After touring the station, the party assembled on the balcony of the control tower to watch a polished demonstration of Canberra formation flying by six crews from No. 57 Squadron, recently returned from their goodwill tour of the Middle East.

The display was excellently stage-managed, with ground crews immaculate in white overalls, and the start-up procedure was carried through with the precision of a Guards' parade. Because of the high wind, rudder locks were only removed on the runway immediately before the take-off, and then the Canberras were on their way. The first four took off in pairs, into a wind of some 40 m.p.h. and the last two separately demonstrated a rocket climb and a short take-off. The quartet gave excellent demonstrations of formation flying, while the remaining two combined in high-speed and low-speed passes, tight turns and various combinations of wheels, flaps and bomb-door extension. One could only have wished that, even under the difficult weather conditions, their "passes" could have followed a little more closely one after the other.

As the six Canberras landed, retrieved their rudder locks and taxied in, two Hunter F1s from C.F.E., piloted by F/L M. Chandler and Captain Don Beck, U.S.A.F. (on exchange posting) made their cartridge start and taxied away close together as soon as their engines were running. They took off as a close pair and proceeded to give a most exhilarating performance. One of them started a battle climb to gain altitude for a sonic boom, while the other roared sharply skywards and disappeared from view. After a few minutes' pause, the commentator announced over the loudspeaker that the sonic boom was due and that the aircraft might possibly appear before the sound was heard. This in fact happened. The Hunter raced silently across Marham several thousand feet up and had passed the aerodrome by the time a thunderous double clap shook the tower, followed immediately by the howl of the aircraft's passing. A thick double vapour puff was visible at about 10,000ft and even as the spectators recovered from this, to them, unwonted experience, the second Hunter passed by at 50ft at full power, only just preceded by its characteristic roar. This was the clearest and noisiest demonstration of the sonic boom we have yet heard. A bang produced when the Hunters arrived at Marham had also shaken the buildings.

F/L. Chandler then proceeded to a blistering beat-up of the tower at an altitude and speed which have seldom been seen before. The Germans on the balcony were given a true head-on view of a Hunter at speed and a good example of evasive action as it veered sharply past them. A Derry turn from a very low vertically banked turn also showed them its remarkable rate of roll. The Hunter will evidently provide squadron pilots with a power of manœuvre and a speed performance incomparably better than any they have had hitherto.

For all the Germans present (and two of the original party were unable to be at Marham) jet aircraft at such close proximity were an entirely new experience, and there is no doubt that they personally were impressed. Their main interests, as stated above, however, covered more than simply aircraft; they were interested in much of what they saw which was concerned with that part of R.A.F. organization which the Englishman takes for granted.



The first three of the six Canberras make a fine snap break for landing. Dive brakes are already extended.

"Flight" photographs

The German delegation talks to the Hunter pilots (left to right), Herr F. Berendsen, Capt. Don Beck, U.S.A.F., F/L. M. Chandler, Dr. R. Will, Herr A. Gleisner, and A.V-M. E. C. Hudleston (A.O.C. No. 3 Group, Bomber Command).

Two comparable, but dissimilar, all-weather fighters, the D.H. 110 (top) and the production-type Gloster Javelin F.A.W.1, are illustrated here immediately after touching-down. Compared with the Javelin, the 110 is using less flap; on the other hand, its air brakes are open and the all-flying tail is at considerable negative incidence.

"Flight" photographs

AIRCRAFT INTELLIGENCE

U.S.A.

Chance Vought A2U Cutlass. Powered by twin Westinghouse J46-WE-18 turbojets with afterburners, the A2U-1 is a ground-attack development of the Cutlass fighter, embodying heavier armour and atomic capability, the maximum underwing load being 9,000 lb. It is reported that orders for 96 A2U-1s have been cancelled by the U.S. Navy, owing to the fact that engine and airframe delays have held up the aircraft to a point at which it will no longer be regarded as first-line equipment. The A2U airframe seems expensive, for the 96 cancelled airframes will save £27m; a similar sum will be saved by the cut in J46 production, the money being used to purchase newer aircraft, such as the F8U, also of Chance Vought design.

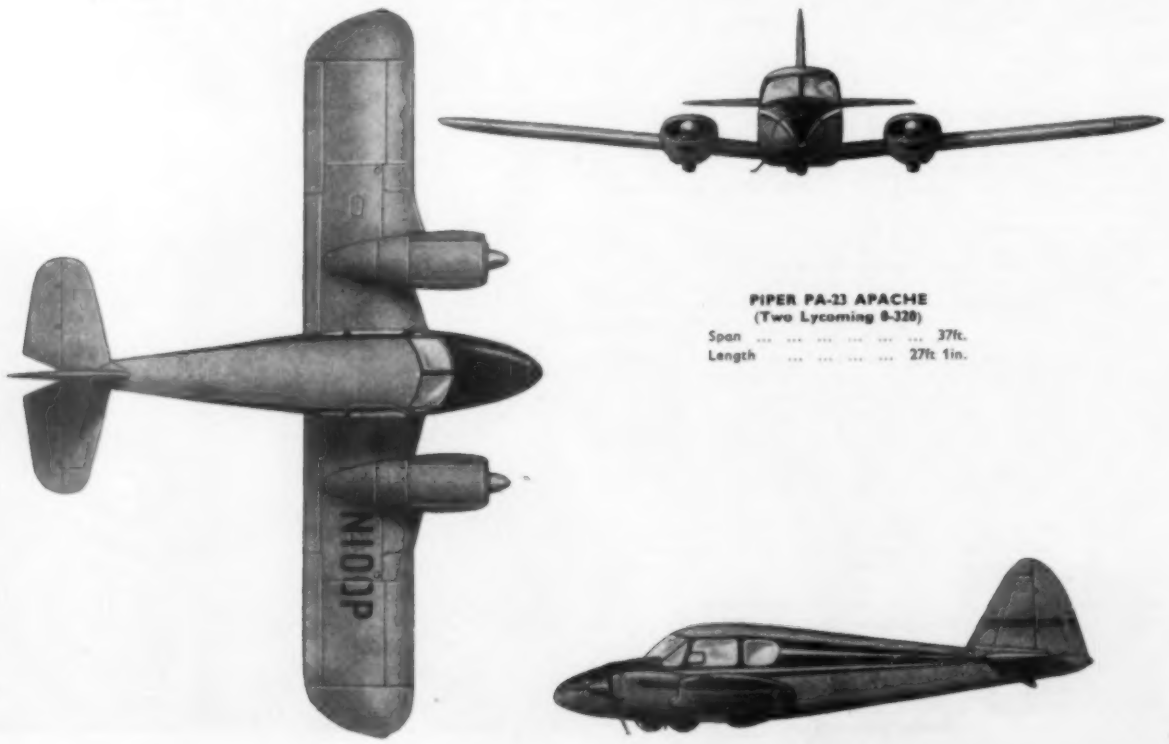
McDonnell F3H-2 Demon. Two hundred of these large single-seat carrier-based fighters are being cut from U.S. Navy requirements, under the same programme as that affecting the A2U Cutlasses (see first item). McDonnell have already made a number of Demons at St. Louis, the early batches being powered by an afterburning Westinghouse J40. After about the 60th machine, the turbojet was to have been changed to an advanced model of the Allison J71, of greater thrust and efficiency, but this engine is subject to development delay. Cancellation of the 200 Demon airframes will save £48,200,000, and the "more than 200" Allison J71-A-2 turbojets about £13m—a relatively low figure.

France

Breguet 1060. Work has begun on a high-speed towed-target aircraft with this designation. Aerodynamic features are being explored with the aid of models.

Sweden

Saab-29. About half of the total operational strength of the Royal Swedish Air Force is now made up of various versions of the very effective Saab-29. The most numerous type is the J 29 (no hyphen, "J" indicating *jaktplan*=fighter), of which the J 29B is the present production version. Almost identical is the A 29 (attack), whereas the S 29C (*spaning*=reconnaissance) is a considerably modified photographic aircraft with the cameras housed in a bulge beneath the forward fuselage. Not yet in service is the J 29F, with an afterburner (all Saab-29s are powered by the Swedish-built Flygmotor Ghost turbojet) and a modified wing.



PIPER PA-23 APACHE
(Two Lycoming 0-320)

Span	37ft.
Length	27ft 1in.

Air Power at Sea

H.M.S. EAGLE

Eagle, an armed East Indiaman of the early 17th century; Eagle, The Royal Navy's largest aircraft carrier — first and twenty-first of England's fighting ships to bear the name. Eagle of 1625 carried twenty-two guns. Her modern successor launched in 1946 will operate Fairey Gannets, the latest and most powerful anti-submarine air weapon from a long line designed and produced by Fairey Aviation for the Fleet Air Arm.

Much of the Navy's striking power rests in her carriers, a large proportion of whose aircraft now as hitherto are of Fairey design and construction.

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FAIREY

Powered by an Armstrong Siddeley "Double Mamba"

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Javelin
twin Sapphire fighter

The Gloster Javelin is one of several leading aircraft powered by Armstrong Siddeley Sapphire turbojets. These engines, of the greatest strategic importance to the Western air forces on both sides of the Atlantic, are in quantity production.

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The Auster A.O.P.9, sporting its extended dorsal fin, operates happily from a rough stubble field near Rearsby. On the right it takes off (a little more steeply than usual) with flaps and ailerons drooped, while below it is settled on the final approach at 45 to 50 kt.

"FLIGHT" photographs

Proving the A.O.P.9

SINCE October 4th, the Auster A.O.P.9 has been undergoing its intensive flying programme in the hands of the makers' pilots at Rearsby, near Leicester. That these trials were conducted by the makers is somewhat unusual, since intensive flying is normally undertaken by the appropriate Service unit or by Boscombe Down. Being a light aircraft, however, the Auster lies on the fringe of Boscombe Down's interests and capacity, and for this reason the firm were given the task of performing under contract the comprehensive series of closely regulated operations, designed to detect any of those teething troubles which often crop up in every new Service aircraft. The arrangement in this case has been most advantageous, since any such troubles could be remedied on the spot during the trials, and the modifications then checked for effectiveness. Conditions of the trials are stipulated in such detail that the results could hardly be less valid than those which would have been obtained by Boscombe Down over a considerably longer period of time.

The trials called for some 141 hours of all types of flying, divided as follows: (1) Circuits and landings (70 hours)—each take-off against the brakes from a 200-yd diameter circle, with records of maximum engine temperatures; and short landings, again within the circle, and occasionally in cross-winds up to 15 kt. (2) Actual reconnaissance sorties with a specific task (11 hours) some with a period of five minutes every hour at full throttle, carrying an observer, and bringing back a complete operational report. (3) Rough handling (six hours), during which pilots were instructed to maltreat and mishandle the aircraft continually. (4) Endurance at various engine settings and altitudes (30 hours), with some flights made to the point of fuel exhaustion and with a variety of loads and engine settings; fuel exhaustion was of course arranged to occur over Auster's own airfield, and was followed by a normal glide landing; maximum endurance obtained with the standard 16-gallon fuel capacity was 2 hr 48 min at economical cruising power. (5) Night flying (four hours), with the specific object of assessing the efficiency of instrument lighting and visibility, with special reference to reflected glare from lighted areas on the ground, ease of course-keeping at night and other similar factors. (6) Flying in rain (five hours), this figure being perforce exceeded because of prevailing bad weather during the period of the trials. (7) Coarse throttle handling (two hours), entailing sudden opening and closing of the throttle and observation of engine behaviour throughout; rapid throttle opening produces immediate engine response, due to direct fuel injection of the Bombardier, a useful factor. (8) Finally, 13 hours of rough field circuits and landings were called for, and were made in a stubble field hard by Rearsby.

The accompanying *Flight* photographs show these landings in progress, with Mr. L. A. Leetham of Austers at the controls. Hussenot recordings have shown up to 3 g during landing runs in this type of field, yet the undercarriage has caused no trouble at all and it is said to be very difficult to bounce the A.O.P.9, thanks to the excellent damping qualities of the two Dowty Liquid Spring units. The company's pilots reported that the handling characteristics were pleasant, with excellent aileron control and a convenient cockpit arrangement. Mr. Leetham in fact brought the A.O.P.9 in to land only a few feet away from observers on the ground, thus demonstrating his confidence in the aircraft's ground handling characteristics. Landing distance in the many circuits observed was invariably some 60 yd, and take-off distance 90 yd.

Comprehensive records have been kept and all servicing has been supervised by Service N.C.O.s seconded to Austers. The Bombardier has been run on ordinary M.T. fuel of up to 80 octane throughout the trials and in this condition delivers 170 h.p. Apart from minor modifications to seat-cushion shapes and for draught exclusion, no serious snags had been found up to the time of writing, when the trials were very nearly complete.

Mr. L. A. Leetham, one of five of the company's pilots engaged on the trials, touches down only a few yards short of the camera for a landing in the stubble field. By this time some 850 landings had been made.

A Pioneer landing at Fort Shean. The strip is about 150 yd long, and at the end of the runway, behind the aircraft, is a 15ft drop into a stream.

JUNGLE PIONEE

(Above) In the heat of the Malayan sun three Pioneers await to emplane troops. (Right) A single machine on operations "up country."

A Pioneer photographed immediately after leaving Kuala Lumpur, having been despatched to lift troops out of Fort Iskandar.

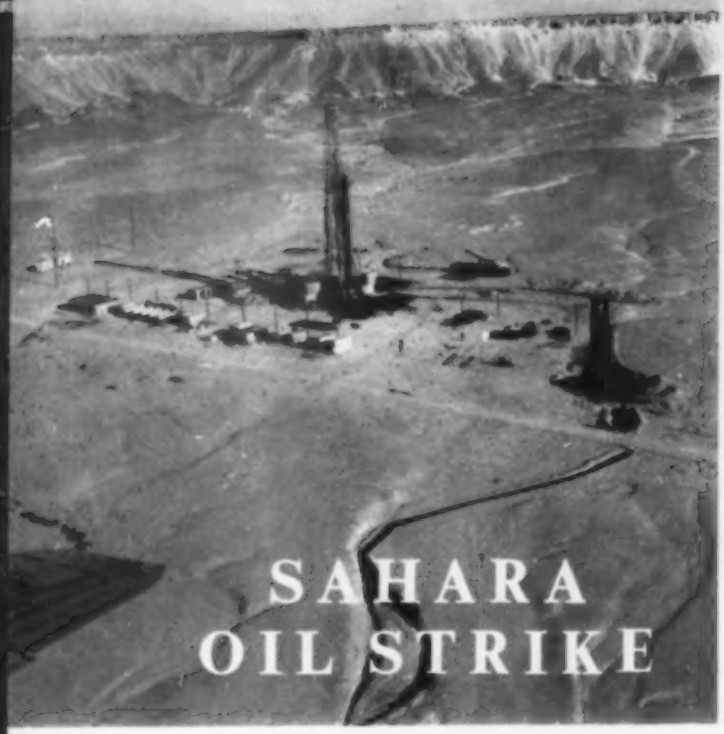
THE LAUDABLE PERFORMANCE of the Scottish Aviation Prestwick Pioneers serving with the R.A.F. in Malaya is the more remarkable in that the aircraft, as a type, underwent no Service trials previous to despatch. The R.A.F. machines are operating as a support flight of No. 257 Squadron, based at Kuala Lumpur, and since the commencement of their operations have been under the command of S/L. Hickmott. Their work in the main has been the relief of garrisons in the Malayan jungle forts, to which they carry replacements and lift out men for rest periods. They also serve for ferrying members of the Malayan Police, and other personnel whose duties regularly take them into the jungle fort areas.

It is fitting that the work of the Pioneers, of their pilots and ground personnel, and of the men whom they bear into and out of the fighting area, should have been recorded by two outstanding sets of photographs, from which our present selection has been made. Forcefully they suggest the heat and hazards of the wild Malayan scene.

The R.A.F. version of the Pioneer is designated Pioneer C.C. Mk 1, though in civilian service the identical aircraft is known as the Pioneer 2. By virtue of its high-lift devices and the 550 h.p. take-off output of its Alvis Leonides engine, it clears 50ft. under temperate conditions, in only 180 yards.

Back-tracking on the strip at Fort Shean.

Local interest in a Pioneer at Fort Shean.



SAHARA OIL STRIKE

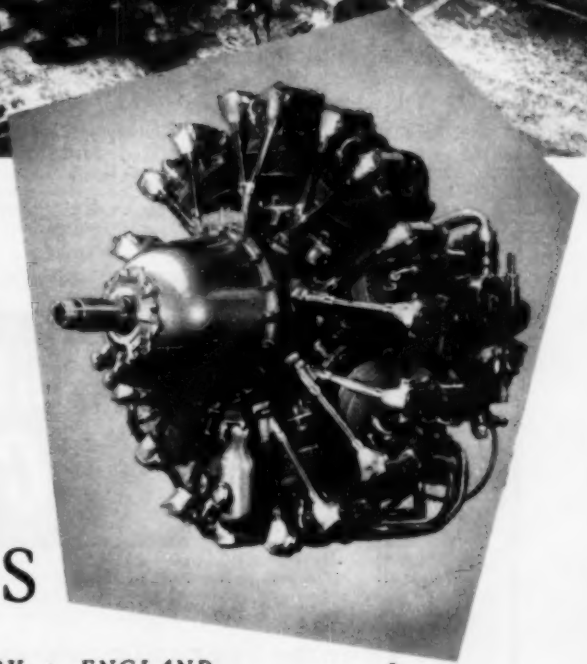
FOR some time a French oil-drilling team had been at work without success near the In Salah Oasis in Southern Algeria; then, suddenly, at a depth of 4,600ft, the drill from one rig broke into oil-bearing strata. There was a violent eruption of natural gas and oil-bearing mud and it became necessary to rush to the site 60 tons of equipment—including a stop-valve weighing seven tons. Though lorries could use the camel tracks between Algiers and In Salah it was doubtful whether they could carry heavy loads through shifting sands. Six Breguet Deux Ponts aircraft (four 2,400 h.p. Pratt and Whitney R-2800 engines) were accordingly chartered from Air France for a high-speed airlift. They delivered the initial 60 tons in 24 hours and another 200 tons in 96 hours, flying day and night from Algiers to a landing strip near the oil well. The striking photographs on this page were taken during the operation. Now there is talk of building an oil pipe line, partly with the aid of air-lifted equipment.

Known in Air France service as the Provence, the Deux Ponts is used by that airline on scheduled services within France and between France and North Africa. No fewer than 107 passengers can be accommodated on the two decks of this impressive machine; when freight is carried, the entire maximum load of 16 tons can be stowed on the lower deck.

Reliability

The Golden Pagoda SHUEDAGON KYAUNG dominating Rangoon.

Powered by ALVIS LEONIDES Engines, six Hunting Percival Provost aircraft for delivery to the Burmese Air Force, flew the 5,700 miles in 8 days in 17 stages — according to flight plan. In the services, as in commerce, the Leonides proves once more its outstanding reliability. 550 b.h.p., 9-cylinder air-cooled radial engine. Weight complete 796 lb. Power/weight ratio 1.45 lb. per b.h.p. Overall diameter 41.5 inches.



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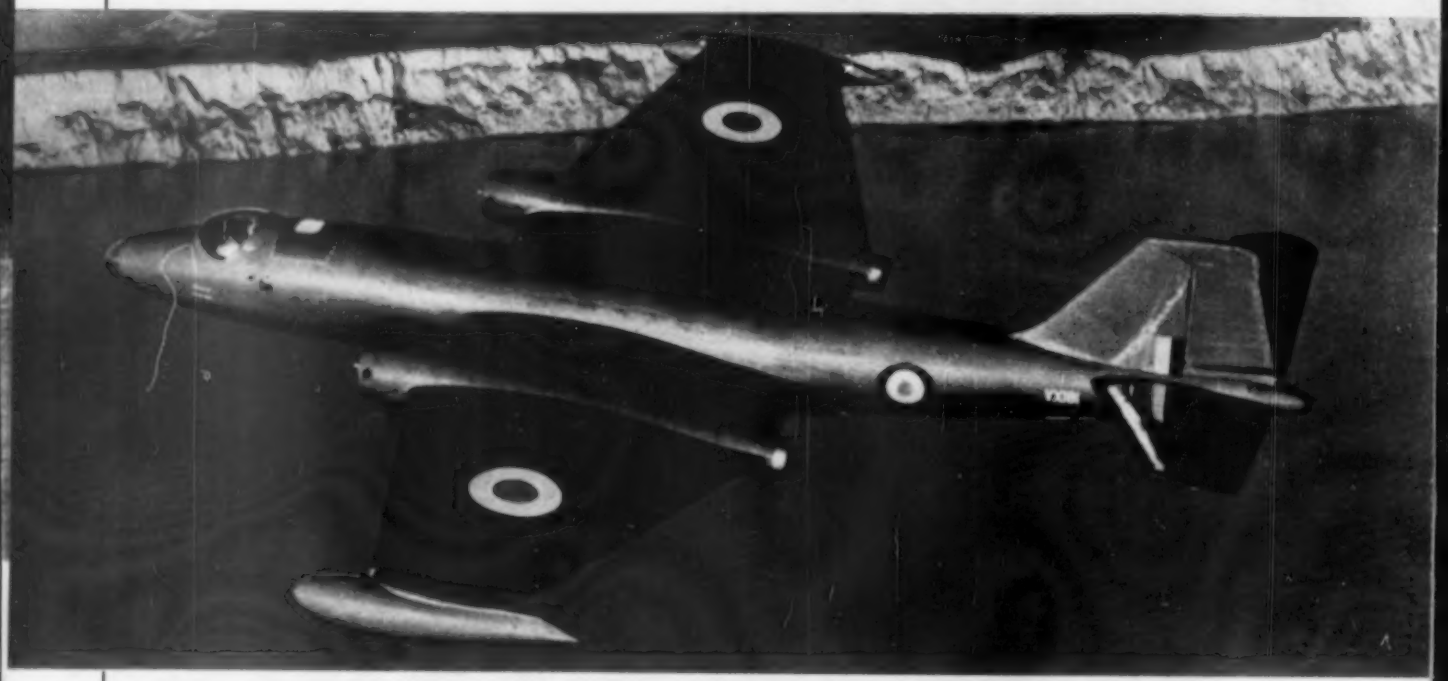

★ The ENGLISH ELECTRIC Canberra (powered by two Bristol Olympus engines) holds the world's height record for aircraft at 63,688 ft.

★ The ENGLISH ELECTRIC Canberra (powered by two Rolls-Royce Avon engines) holds 12 world speed records, including London to Christchurch (New Zealand) at an all-in speed of 494.5 m.p.h.

'ENGLISH ELECTRIC' *Canberra*

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Liverpool Prepares for Helicopters

SPEAKING at a Liverpool Luncheon Club occasion recently, the engineer and surveyor of that city, Mr. H. T. Hough, made a number of observations regarding the possibilities of future helicopter operations and of his city's plans to be prepared for such developments. It was gratifying to learn of the efforts this far-seeing municipality has made to keep itself abreast of early helicopter operational experience and to gain as much knowledge as possible in readiness for proposed B.E.A. and other services.

Mr. Hough led up to the subject of helicopters by referring to the congestion caused by road vehicles and the difficulty of providing parking facilities in Liverpool and other cities, both here and in America. (This was another subject upon which Mr. Hough is apparently an expert.) He said:

"Traffic congestion, the financial difficulty which prevents the provision of adequate roads for quick transport for medium distances, and the comparatively long time taken on train journeys for long distances are factors which are opening the eyes of the public in this country to the advantages of helicopter travel. In fact just as the railways outmoded road travel many years ago, so may the helicopter take the place of some of our modern road vehicles—once again for the same reason: the inadequacy of the roads.

"The Liverpool City Council has long been aware of the advantages of helicopters and the Post-War Redevelopment Committee has for some time given careful consideration to the possibility of providing landing stations which will be ready for use as soon as safe and economical machines are available to airline operators.

"Liverpool does not claim to be the only city to be making such preparations, and it is hoped that the other large cities and towns in the country will not lag behind, since inter-communication is not possible if only one city has landing facilities.

"On June 1st, 1950, the first regular inter-city, scheduled helicopter passenger service in the world was inaugurated when two helicopters left Liverpool for Cardiff. This service continued until March 31st, 1951. The machines used were Sikorsky S-51s.

"In June 1953 Liverpool was able to witness the capabilities of a British-designed helicopter, the Bristol 171, which landed in the heart of the city on a war-damaged site within 100 yards of the main shopping street.

"During the past few years I and members of my staff have made careful investigation into the landing station requirements of helicopters in conjunction with development engineers of B.E.A. and of aircraft companies engaged on the development of the machines."

On the subject of municipal landing stations Mr. Hough continued: "There should be no tendency for a helicopter station to be compared with an airport. One of the chief advantages of the helicopter is that like a bus it can stop anywhere where there are simple landing facilities.

"The landing station should not be complicated and expensive, otherwise the helicopter, with its unique ability to drop from the sky into a small space, will lose one of its advantages. The passengers should experience no more formalities than they encounter at a railway station.

"Liverpool has in mind several surface landing sites in its long term plan, and in addition it has approved in principle a roof-top landing site over a bus station and multi-storey car park in the City centre itself where, due to war damage, land is already available for its erection between Paradise Street and South John Street.

"The financial aspect of a roof air stop is important, since the erection of an elevated landing ground serving no other purpose would be far too costly. Even the roofing over of a railway station as a landing area would seem too extravagant to enable reasonable landing fees to be charged.

"A central air stop should, therefore, be envisaged as a strengthened roof of a building or group of buildings required for other purposes. They should be as tall as possible, at least fifty or sixty feet, so that the expense of the roof strengthening would be but a small proportion of the cost of the main structure —the height would, of course, be an advantage both for operational purposes and reducing the noise at street level.

"It is too early in the life of this new mode of travel to forecast with certainty the form of the ultimate landing station, but it cannot be emphasized too strongly that the helicopter should be regarded as a bus rather than an aeroplane or train. Its value lies in its flexibility and the fact that it is a small unit. It is envisaged that it will be most useful when carrying between twenty-five and fifty passengers, thus enabling more frequent services to be operated than is possible with railway trains, which carry much larger numbers at rather long intervals. The helicopter's inherent freedom from the necessity of expensive ground works such as railway permanent way and bridges, stations and tunnels, or large and expensive airports, must not be discounted by saddling its operators with heavy landing fees on extravagantly designed landing stations.

"It will probably be ten to fifteen years before a stage is reached where the frequency of helicopter services will justify the construction of more than one airstop in any but the largest cities, but now is the time for preserving suitable sites from other buildings by defining them in the long-term development plans."

In June and July 1953, Mr. Hough, together with the Chairman of the Liverpool Post-War Redevelopment Committee, Sir Alfred Shennan, M.A., visited the United States. Of this visit he said: "Unique opportunities were obtained to study the operation of helicopters and to discuss the design of helicopter landing stations with various authorities. Those using and operating helicopters are very enthusiastic and are pleased with the successful results which have so far been obtained.

"It is the opinion of experts that for distances up to 200 miles a coach-type helicopter is likely to be operating between city centres in the U.S.A. within the next five to ten years.

"The reason for the confidence displayed in the probably quick development of the helicopter in the United States is due to the fact that the roads in and near towns are constantly congested with traffic, and it is becoming more and more difficult for executives, and others, of local authorities, port authorities, the central government and companies having numerous branches, to reach their outlying offices or depots without wasting much time in the negotiation of traffic blocks.

"In order to overcome this difficulty the Post Office and the New York Port Authority have already acquired helicopters and are operating them very successfully.

"I had the good fortune," said Mr. Hough, "to experience a flight from Newark Airport to the Port Authority's offices in Manhattan, a distance of 15 miles, where the helicopter landed on the roof of the 16-storey building. A platform 45ft by 40ft in area, which is raised above the general level of the main roof, is used as a landing station. The Port Authority commenced a service for the conveyance of passengers between the various airports on July 10th, 1953."

In conclusion, Mr. Hough said: "I am of the opinion that despite the many more thousands of hours flown by helicopters in the United States sufficient experience has been gained in Britain in the operation of passenger and freight services since the formation of the British European Airways Experimental Unit in 1947 to ensure that operators in this country will not be behind those in America when the availability of multi-engined helicopters makes it possible for inter-city passenger services to be operated with the required standard of safety and at economic fares.

"It would appear, however, that roof-top landings are not likely to become common for several years in view of the various problems to be overcome.

"I hold the view that helicopters and their landing stations are complementary to each other and that their development should proceed side by side.

"*From Car Parking to Helicopters* is the title of this talk, and I hope that the link between the two is appreciated—it is the increasing congestion of our roads. Already the Duke of Edinburgh is finding car travel too slow and is using helicopters. But in spite of their usefulness let us hope that we are not driven to using them because, owing to traffic congestion, we cannot get out of or into our great cities by any other means."

PHOTOGRAPHIC SYMPOSIUM

ON November 30th, following its second annual general meeting, the Photogrammetric Society held a symposium on *Navigational Problems in the Photography of Unmapped Territory from the Air*. Under the chairmanship of Col. R. C. A. Edge, Deputy Director of Geodetic Control, Ordnance Survey, the meeting was opened by G/C. J. Bussey, Assistant Director (Air) of Colonial Surveys, who outlined some of the problems associated with aerial survey and photography; these problems were further discussed by subsequent speakers. Mr. L. D. Carmichael, who is Chief Cartographer of Colonial Surveys, and Mr. M. L. Richards, chief photogrammetrist of Hunting Aerosurveys, Ltd., spoke of their particular spheres in this method of map-making, and they were followed by Mr. J. B. Symington, also of Hunting Aerosurveys, and Mr. B. J. Attwell, research manager of the Air Survey Co., who discussed respectively the operational side of aerial survey and photography, and some of the systems under development for this work.

An impressive turn-out of Fireflies and Sea Furies at Ford—for Royal review.

CHANNEL AIR DIVISION

A Visit to the R.N.V.R. Squadrons at Ford

By DAVID F. OGILVY

JUST as the Royal Auxiliary Air Force now falls within Fighter Command and is considered part of Britain's first-line defence force, so do the air squadrons of the Royal Naval Volunteer Reserve hold a similar status within their own service and function at various land bases as fully blown operational units. A recent visit to the R.N. Air Station at Ford in Sussex, headquarters of the Channel Air Division, made it clear that this certainly is no mere nominal claim, for the efficiency and enthusiasm with which its two squadrons occupy themselves at week-ends reveal that here is a very important but much under-publicized section of the Fleet Air Arm.

However, to the beginning: although there are now five divisions (the Scottish at Donibristle, Northern at Stretton, Midland at Bramcote, Southern at R.A.F. Benson and the Channel Division at Ford) there has been extensive expansion within the past few years and all the activities south of Bramcote have been "stretched" from one squadron, No. 1832, which formed at Culham, near Oxford, in July 1947.

In April 1951 eight pilots and eight observers were detached from 1832 (then flying Seafires and Harvards), allotted a mixed bag of Firefly 1s and 3s and numbered 1840 squadron. Three months later they transferred their home to Ford, disposed of their temporary equipment and started afresh with Firefly 6s straight from the factory. This initiated the parting of the ways, for the Culham unit expanded into three squadrons which now form the Southern Air Division at Benson (the fortunate possessors of Sea Furies, together with four Harvards and a Dominie), while 1840 subsequently outgrew itself and gave birth to 1842, these two squadrons forming the Channel Air Division with which we are primarily concerned.

Most of the original crews from Culham are still with the unit today and, in fact, the commanding officer, Cdr. (A) N. H. Bovey, D.S.C., R.N.V.R., was in charge of 1840 when it first broke loose from 1832. However, there are several R.N. personnel on strength, among them Lt-Cdrs. John Shoebridge (Staff Officer), D. Fuller (C.F.I.), J. Foulgar (an observer, C.G.I.) and D. Mackenzie who, as Lt-Cdr. (E) has under him an almost entirely Regular maintenance staff who have their "week-ends" on Tuesday and Wednesday.

Among the pilots and observers at Ford are men from many professions; the division boasts two solicitors, two estate agents, several commercial travellers and personnel managers, and quite a handful of schoolmasters. Also, there are at least four who earn their mid-week bread, butter and beer from flying: Lt.-Cdr. Hamish Sinclair flies Hornets for Airwork at Hurn, Lts. Anthony Hoare and "Paddy" Prior (the latter the only ex-R.A.F. pilot on strength) fly for the same company at St. David's, and Lt. Brian Barford occupies the right-hand seat of an Elizabethan for B.E.A.

The two squadrons, each operating primarily in an anti-submarine rôle, function on alternate week-ends, so that attendance is expected on two Saturdays and Sundays out of four; however there is no rigid line between the two units, and a member of 1840 is both permitted and encouraged to fly when 1842 is on duty and, of course, *vice versa*. Naturally there are a few enthusiasts who are present almost every week-end and these (restricted mainly to bachelors who are "allowed out" whenever they please!) amass about 180 hours each year, compared with the required minimum of 80.

In addition to this "casual" service, there is the annual fortnight's continuous training, when the squadrons pack their bags and get down to serious business away from home. In 1952 the pilots became very nautical of habit and spent their time in H.M.S. *Triumph*; in 1953 they crossed to Eglinton in Northern Ireland; and this year they ventured to Malta. This, if not proving their operational efficiency, certainly reveals their mobility.

The Firefly A.S.6, like most Naval strike aircraft, carries its share of protuberances, but even if the observers would appreciate a change to something a little more modern (the Seamew, quite naturally, has been rumoured) the pilots are not overanxious to part with their equipment. The cockpit is tolerably neat and not unlike that of the average piston-engined fighter, the standard panel having now a gyro-compass in place of the old direction indicator with which many of us were familiar and happy. The observer's position, however, appears to be full of accumulators and odd specialized tools of the nautical trade, to the exclusion of all normal navigational aids. Apparently D.R. remains the way to get there and home again (sometimes with a moving home, too!) and we were wasting both time and energy searching for a Gee-box.

When we enquired about performance, we were told that the Firefly started life with much the same low-altitude figures as the Mosquito, but that, as bigger and heavier equipment was fitted, so did the speed and rate-of-climb decrease; to which we replied that the Mossie, too, had not been completely free from this particularly unkind form of punishment. The answers remained comparable, for the Firefly cruises contentedly at 180 kt I.A.S. using +5 lb boost and 1,900 r.p.m. We erred by asking the over-the-fence speed for there is no such term in Naval aeronautics; but apparently the final approach is made on a runable basis at 85 kt indicated.

Sonobuoy equipment (much improved since the war) forms the main medium for anti-submarine search, and its fairing lives under the starboard mainplane to balance a fuel drop-tank on the port side; for ferrying and other long-range duties it can be removed and "drops" fitted to each wing. Normal training sorties are of approximately two hours' duration, although when we visited Ford at the end of September air-firing was taking precedence over the normal occupation of hunting, for the five R.N.V.R. divisions were shortly to compete at R.N.A.S. Brawdy for the Kemsley Trophy, each division sending a team of four pilots to be tried at their skill in this particular art.

Quite apart from operational activities, 1840 and 1842 share considerable training commitments, for which they maintain a brace each of Firefly Trainers, Sea Balliol T.21s and Sea Princes. The Balliols earn their keep mainly on instrument flying, for which they are ideally suited owing to the complete duplication of all essential controls and dials, and the Ford squadrons claim an unusually high percentage of "green"-rated pilots; in fact, when we arrived, Cdr. Bovey himself was just recovering from a prolonged and tiring session battling with the dreaded blue goggles and amber screens.

The Princes serve as flying classrooms for the final training of observers, three of whom can practise simultaneously either on sonobuoy screens or on the more dated A.S.H. system. Until twelve months ago this work was performed in genuine vintage Anson 1s, complete with glasshouse and hand-wound undercarriage; and Lt. H. M. Humphreys, who was detailed by the C.O. to show the writer the workings of the unit (and which duty he performed admirably), remarked that he had flown in the very same machines whilst training in 1942. However, they are history now and the Princes seem well worth the wait, especially from the viewpoint of those who sit at the front end.

A recent and practical innovation in the training programme is the attachment to R.N.V.R. squadrons of young National Service trainees for their last six months, during which time they become familiar with the aircraft, tactics and fellow-members before taking their places on the normal part-time basis.

There are many diversions from routine and these vary in character from the Admiral's annual inspection, held in August this year, to a recent search for a yacht that had disappeared from the Isle of Wight. Although the crews were not specifically ordered to take part in this hunt it was considered a good exercise and eventually the missing boat was found near Dieppe.

The general level of spirit and enthusiasm runs high and vacancies for pilots and observers are filled without any difficulty; in fact, Lt-Cdr. Ralph Jamieson, the present C.O. of 1842, spent two years in the R. Aux. A.F., whilst on the waiting list for entry to an R.N.V.R. squadron. It is interesting to note that, by contrast with the Auxiliaries, whose pilots are mainly inexperienced men with a very few hundred hours apiece in their log-books, the Naval equivalent manages to retain many war-time veterans; their numbers still account for more than half the unit's strength. This collection of experience combines well with the youth of the National Service trainees to make an effectively-balanced force of well-trained aircrew available for active and operational service at very short notice.

As most of the reservists are Londoners, the team spirit starts not in the wardroom or at the flights, but in town at 6.15 p.m. on a Friday, when many of them leave their weekday occupations and travel *en masse* by train towards the coast, where they are met at the station by a truck and delivered to H.M.S. *Peregrine* (Ford's official name) in time for dinner at 8 p.m. Thereafter they are ready for a full week-end's activities, briefing starting at 8.30 a.m. and flying continuing until 6 p.m. on both Saturdays and Sundays.

Naval flying technique seems strange to one accustomed to R.A.F. procedure, for not only is every landing made in the best precautionary style, but the circuit differs appreciably. Pilots normally descend to a very low level on the "dead" side of the duty runway, at the end of which they lower their wheels and carry out a sustained curve on to the downwind leg; this seems to be flown at heights between two and four hundred feet almost within the aerodrome boundary, therefore demanding a steep 180-degree curved approach, in the midst of which the airspeed is reduced to a courageously nautical figure. The old adage of five knots for the wife and a few more for each of the children certainly plays no active part in this brand of aviation.

Apart from the Channel Air Division, Ford is the home also of the Fleet Trials Unit, which undertakes the preliminary service testing of new aircraft types before they are delivered in quantity to the squadrons; the Gannet was the most recent design to receive this treatment, but other aircraft are used for a variety of purposes and in little over an hour one afternoon the circuit accommodated a Wyvern, Sea Hawk, Venom, Avenger, Sea Fury and Anson. One later sight, a formation of four Avengers, seemed strangely interesting by comparison with the monotonous Meteors from Tangmere that occupy the lion's share of the local sky; the Sea Fury, too, with its clean lines and 2,400 harnessed horses, never fails to make an impressive picture. It looks the perfect pilot's aeroplane, and probably is.

Also housed there is the "station helicopter," an S-51 Dragonfly used for communications and air/sea rescue duties. In this latter capacity it sometimes "rescues" members of 1840 and 1842 squadrons from their practice ditchings, when they are picked up from sitting in the sea in dinghies; frequently the pilot of the Dragonfly is Lt-Cdr. A. Sproule, whose name is well known in gliding circles.

We came away from Ford very favourably impressed with what we had seen. Such things as really clean aeroplanes, and the laying of a white tablecloth in the crewroom with two white-coated stewards dispensing tea and sandwiches in the middle of the afternoon, may not in themselves materially improve operational efficiency; but they certainly add a touch of essentially Naval quality that we never met during six years' service in the R.A.F. Similarly, a job-card affixed to the fin of a Balliol undergoing a "minor" may not necessarily result in improved servicing, but nevertheless it clearly defines each man's individual task and reveals to all interested parties whether or not the work has been done.

It would be possible to mention innumerable points of this nature; but let us finish our appreciation by saying that, if our normal occupation allowed us sufficient spare time, we would be knocking on the door for admission to an air squadron of the R.N.V.R. almost before anyone knew we had gone!

LORD MONTGOMERY ON NATO

IN speeches at Los Angeles, Field Marshal Viscount Montgomery, Deputy Allied Supreme Commander in Europe, asserted last week that the Western world would never win a war in the air with the organization of air command and control that it has at present. His description of this organization was "unworthy of a group of nations who claim to have some knowledge of war." He went on to declare that the dominant factor of a future war would be air power, adding that the greatest asset of air power was its flexibility. "But the West," said Lord Montgomery, "has sacrificed much of its flexibility by basing the air command organization on the requirements of the 'direct support' of the land forces, whereas it should be based on the organization necessary to gain the greatest measure of control in the air. Air power is indivisible. If you split it up into compartments you merely pull it to pieces and destroy its greatest asset, its flexibility. If we lose the war in the air we lose the whole war and lose it quickly."

The time would come, said Lord Montgomery, when the seas would be controlled from the air. Aircraft would make big naval surface craft obsolete, and we saw the day of the aircraft carrier approaching its end.

U.S.A.F. RADAR PICKET

FOLLOWING the release of the interior views of the U.S. Navy's WV-2 (Super Constellation) long-duration radar picket aircraft, published in *Flight* of November 26th, comes news of a counterpart for the U.S.A.F. Designated RC-121D, this has a total fuel capacity of 8,750 U.S. gallons—2,200 more than previous models. The ship's complement can number as many as 31 men, including two complete flight crews and a group of electronics specialists. Interior changes from earlier models include new radar consoles, with larger viewing scopes. To enable crewmen to obtain the maximum period of between-watch rest there are four lounge-type chairs in the compartment ahead of the radar-filled workshop amidships; there are also eleven bunks.

The first of the new machines was delivered to the Wright Air Development Centre at Dayton, Ohio, and to date others have gone into service with the 4701st Airborne Early Warning and Control Squadron of the Eighth Air Division at Sacramento, California. Similar machines, according to a recent announcement, will soon be guarding the eastern shores of the North American continent from another U.S.A.F. base.

Among the problems confronting Lockheed engineers in developing the aircraft was that of designing a special cooling system to relieve the heat generated by about 3,000 valves used in the radar and other electronic installations.

TRAINING FOR MANAGEMENT

THE Federation of British Industries has published two complementary handbooks on the subject of the employment of graduates in industry. The first, *A Career for the Graduate in Industry*, is addressed to the undergraduate and is being distributed widely in universities and schools; its purpose is to show that there is a wide variety of satisfying careers in industry for both the science and arts graduate. The second handbook, *Industry and the Graduate*, is addressed to industry itself, and is being sent to all the F.B.I.'s 6,800 member firms. These handbooks are available at 2s each, post free, from the Federation's offices at 21 Tothill Street, London, S.W.1. An earlier handbook in the series, *Education and Training for Management*, published a year ago, has been reprinted and is available at the same price.

Showing the section of the C-130's fuselage, the track of the unorthodox undercarriage, and the small frontal area of the Allison turboprops.

HERCULEAN TRANSPORT

The C-130A, and Air Freight, Discussed by a Lockheed Chief Engineer

A SPEECH delivered before the American Society of Mechanical Engineers, by Mr. Robert W. Middlewood, chief engineer of the Lockheed Aircraft Corporation's Georgia Division, has disclosed new facts concerning the C-130A Hercules assault transport aircraft.

Mr. Middlewood recalled that when America entered the second world war she found herself sadly lacking in aircraft capable of carrying cargo efficiently. The available machines were forced to deal with cargoes the designer never dreamed of, and he found himself reinforcing the structure to carry loads far in excess of those originally catered for. The now-famous "hump" operation, from India to China, brought into focus all the shortcomings of personnel transports when used for cargo work, but it did stimulate post-war expansion of air freight. Of the many freight operators who entered the field at the end of the war, however, only a few survived, and undoubtedly those who failed could point to the fact that converted passenger aircraft were improper tools with which to work.

The Berlin Airlift added impetus to the growing realization that an aircraft must be designed as a cargo vehicle if the job were to be done economically, and there were now definite military requirements for transport aircraft to be designed either primarily for cargo or primarily for personnel, without sacrificing the flexibility required to meet war-time exigencies and the vagaries of totally unforeseen circumstances. This philosophy was recently enunciated by the Military Air Transport Service at the National Turbine-Powered Air Transportation Meeting in Seattle.

With specific reference to the C-130, as now being built for the Tactical Air Command of the U.S.A.F., Mr. Middlewood remarked that the introduction of nuclear weapons into tactical warfare had forced a change in combined air-ground operations. Ground units could no longer be concentrated in an area for appreciable lengths of time; they must be able to move rapidly through the air in almost all combat situations. In defining this high degree of mobility the U.S.A.F. classified its required transport capabilities as light, medium and heavy, though actually this definition gave each class some mutual overlap, thus affording maximum operational flexibility. The C-130 was in the medium category.

Tactical Air Command requirements for a new medium cargo aircraft were formalized in early 1951 by the issue of a specification and an invitation to several contractors to submit designs suitable for the transport of personnel and material—these to be dropped by parachute or be landed at hastily prepared airstrips. By the middle of the year Lockheed had received authorization to proceed with development.

One of the early phases of an assault operation, Mr. Middlewood went on, required the use of an aircraft capable of aerial delivery to forward areas of such equipment as bulldozers, road graders, trucks and howitzers. Paratroops had to be released into dropping zones with an acceptable minimum of dispersion; then, after hasty preparation of airstrips, the aircraft would land with equipment too large for air-dropping and with more supplies and troop reinforcements. On the return trip it would evacuate battle casualties.

The new performance requirements specified that one-engine-out capabilities over the dropping zone should be increased by factors of 1.5 to 2. Dependable controllability and stability at low speeds were essential, and design-payload/range capabilities were multiplied by a factor of 8. Assault operation, moreover, required exceptional take-off and landing performance. Throughout the operating range an 8,000ft pressure altitude for crew and cargo compartments were required; an integral ramp and rear door, operable in flight, were demanded for heavy-equipment dropping, and "the limit flight load factor" was increased to 3. Visibility had to be excellent and the floor cargo volume required resembled that of an American railroad box-car measuring 40ft × 10ft × 9ft. The cargo floor was to be at the loading level of standard trucks, and the undercarriage must enable the aircraft to operate from fields of clay, sand or humus.

Simplicity, reliability and rugged construction became the primary factors in Lockheed's design philosophy, and economy of manufacture, operation and maintenance were other prime objectives. The one-engine-out condition fixed the need for four engines, and because economy was a goal turboprops were selected for their long-range performance characteristics at high altitudes. Allison T56-A-1s, rated at 3,750 e.s.h.p., combined with the Curtiss-Wright turbo-electric, full-feathering, reversible three-blade airscrews to meet the requirements very satisfactorily. The long-range and high-altitude factors meant a high-aspect-ratio wing, and a cargo floor at truck-bed level placed the wing high on the fuselage. Lockheeds finally settled for a wing of 10 : 1 aspect ratio, 132ft span and 1,745 sq ft in area. A relatively conventional arrangement of cargo space, troop seating and stretcher tiers, was evolved after design studies had proved, once again, that simplicity was a virtue. Wind-tunnel tests solved the aerodynamic problem of fairing the aft fuselage, containing the ramp and door. The flat, elliptical end-section provided sufficient stiffness for the empennage, expanded rapidly into a cone-shaped section, and faired smoothly into the primary fuselage. Overall fuselage length turned out to be 94.8ft, and the tip of the single vertical fin was 38.3ft from the ground.

Soft-field tyre "flotation" characteristics, smooth wheel-well profiles and minimum structure weight all seemed to point towards a tandem-wheel arrangement, with two large low-pressure tyres in fuselage side-blisters, for each main undercarriage. As the general arrangement began to take form the empty weight was settled at 57,500 lb and gross weight at 108,000 lb, with a design payload of 25,000 lb. The alternate gross weight became 124,200 lb, with a much higher payload at acceptable, but reduced, load factors.

In addition to conventional materials and processes a number of new ones were used to obtain increased performance and serviceability. Metal bonding allowed the use of lighter gauges, and the aircraft contained about 100 thin-gauge aluminium assemblies. Typical applications involved the joining of doublers and stiffeners to the skins of wing and empennage trailing-edge assemblies. The use of metal bonding was, however, restricted to relatively flat panels, in order to minimize production problems during the period when shop techniques were being developed. Even so, a number of problems arose and the biggest factor in solving them was the careful training of personnel in the preparation and handling of parts for bonding.

A newcomer in the aluminium-alloy field, A78S-T, was extensively used, mostly in the form of plate and extrusions for the primary structure—particularly integrally stiffened skins. Here,

said Mr. Middlewood, the 7 per cent increase in allowable stresses over those permissible with 75S-T offered the best opportunity to reduce airframe weight. Approximately 210 individual A78S-T parts, a number weighing over 100 lb apiece, were designed into the aircraft, and it was believed that this constituted the widest usage of this material in any aircraft today.

The upper and lower surfaces of the entire primary wing structure were made from plate stock machined to provide integral stiffness. The largest panel was 48ft long. The cargo floor was made of a series of integrally stiffened extrusions and integrally stiffened machined parts. In specific applications high-heat-treated steel in the 260,000 to 280,000 lb/sq in range had been used and about 140 such parts were now being employed in each C-130A. These parts were made from 4340 steel, and typical applications included nose and main landing-gear assemblies, latches and hinges for large pressure doors, and special bolts.

Titanium was used in engine nacelles and for flap skins. This was commercially pure sheet, since high strength was not a design requirement as were heat- and corrosion-resistance and formability. Using titanium as a replacement for stainless steel, Lockheeds were able to achieve a 25 per cent weight saving. There were about 300 lb of titanium parts in each aircraft and, as shop techniques developed and titanium alloy specifications became more settled, the alloys would also be used for sheet metal and machined parts. The greatest deterrent to more extensive use of titanium was its present high cost.

The desire for an integral ground heating, cooling and ventilating system, which was independent of the main power plants, was fulfilled by the use of an auxiliary gas-turbine compressor. This, too, was a source of high-pressure air for pneumatic starting of the turboprops. The air turbine motor driving a D.C. generator and emergency hydraulic pump could be operated by air from the same auxiliary power source or by air bled from the engines of the aircraft.

Proven hydraulic power-boost systems were used in all three of the aircraft control systems and provided excellent manœuvrability through a wide range of speeds. As an insurance against loss of hydraulic pressure, all boosters were given two separate and independent hydraulic systems. These were labelled "boost system" and "utility system" and each was pressurized by two hydraulic pumps. The boost-system pumps were on engines 1 and 3, and the utility-system pumps on engines 2 and 4; any one pump could operate all three boosters under normal flight conditions. The utility system also supplied pressure for undercarriage and flap operation, brakes and nosewheel steering. Although Lockheeds felt that the probability of complete booster failure was "quite low," the aircraft could be controlled in all flight conditions by means of independent electrically operated trim-tabs, which could be energized by the D.C. generator or even by the batteries. Actually, some measure of control was possible with pilot effort alone, particularly at low speeds.

A "rather conventional" arrangement of flight crew stations was arrived at without any sacrifice in operational effectiveness. The single power-control lever for each turboprop necessarily led the way to further simplification; for instance, fuel and electrical control panels were designed to serve as animated flow-diagrams which, it was hoped, would contribute to operational safety.

Predicted average cruising speed turned out to be 20 per cent faster than the minimum requirements; normal-power ceiling and rate of climb were 35 per cent higher; normal-power one-engine-out ceiling and rate of climb, respectively, 35 per cent higher and 55 per cent faster; take-off distance with maximum power was 25 per cent less; and, finally, landing distance (using brakes only) showed a 40 per cent decrease. Notwithstanding its relatively large size and weight, the Hercules was said to have the flying qualities of a much smaller aircraft. Control forces were very light, and even at low speeds the combination of these low forces with high inertia seldom gave the pilot any impression of sluggishness.

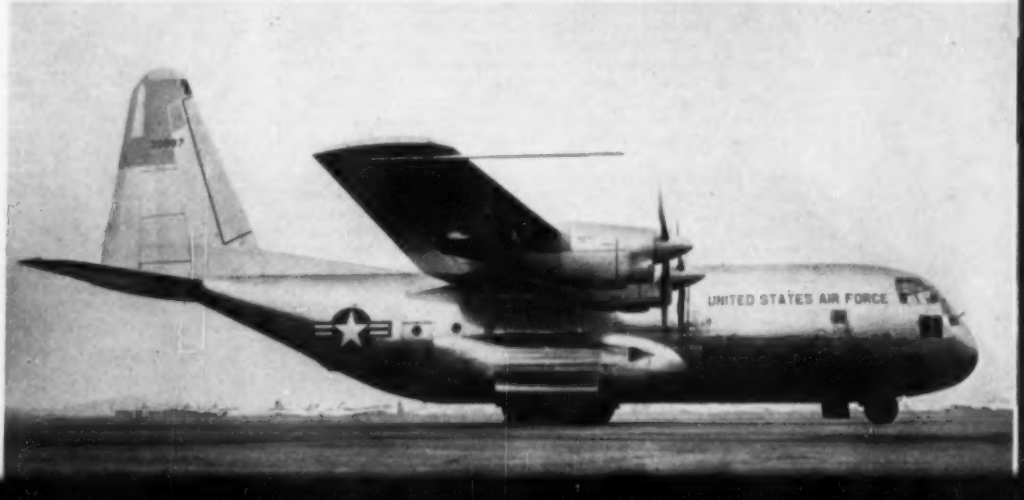
The builder and user of the aircraft had each evolved formulæ by modifying those issued by the Air Transport Association. Lockheeds could apply their own modification of the A.T.A. formula, and show eight cents per ton nautical mile for the design gross weight condition and 5.5 cents for the alternate take-off gross weight condition. "Or," the speaker went on, "we can use those issued by Project Rand and come up with six cents per ton nautical mile for the C-130A design range, normal payload, and limit flight loads factor of 3. Suffice it to say, we can now predict that the airplane as presently being built is in the low direct operating cost class. Further, we have reason to believe that the indirect operating costs will be less than half of the direct operating costs, inasmuch as the C-130A can be loaded from docks, similar to trucks, or directly from trucks." The rear ramp and door gave ready access to the entire 9ft × 10ft cross-section of the loadable volume, and a forward 88in × 73in door made it possible to load from both ends, thus shortening cargo handling distances.

In common with other aircraft manufacturers, the speaker said, Lockheeds had been, and were still, asking themselves some "rather searching questions" regarding the nature and amounts of present and potential air cargo, in order that their design would better solve diversified logistics requirements. A tabulation of one month's traffic through Slick Airways' Chicago terminal had been made, in conjunction with Slick, by Lockheed and Douglas. The average density of 4,000 pieces and a quarter of a million pounds of cargo was about 21 lb per cubic foot. Sixty-seven per cent of the individual pieces were over 20 lb per cubic foot in density, 75 per cent were hard goods, and the favourite container size was less than 6 cu ft. Lockheeds had also been given the opportunity, with other manufacturers, to observe M.A.T.S. pallet loading demonstrations at Travis and Westover Air Force bases. At Travis 75 per cent of the material in the warehouse was 8 cu ft or more in volume, and 50 per cent was 32 cu ft or more.

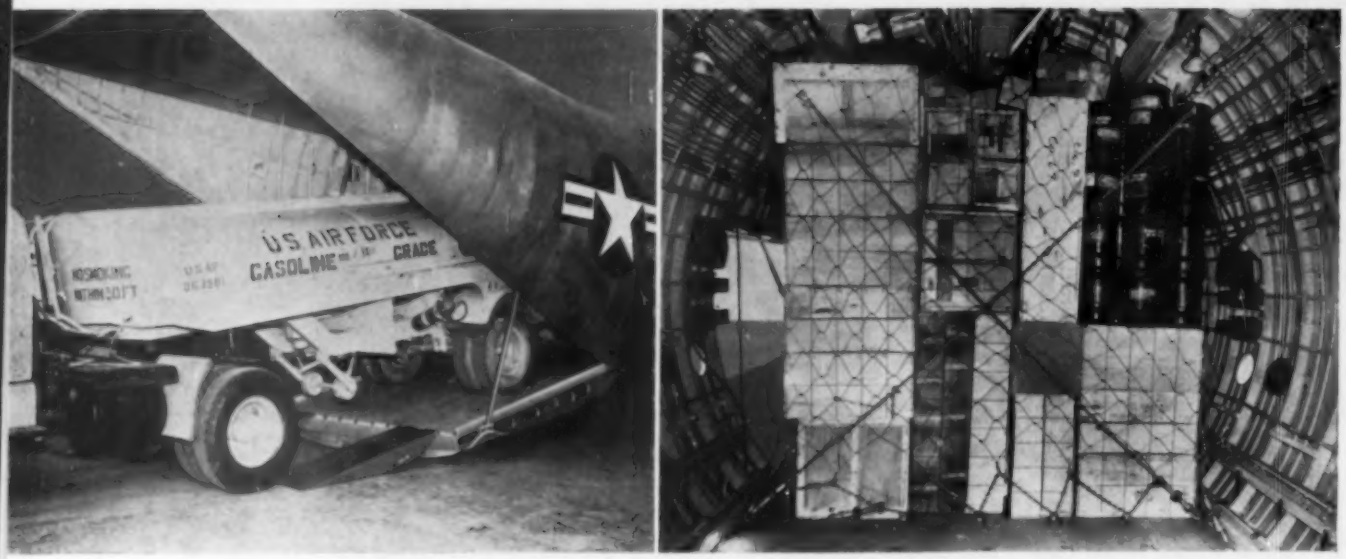
Several inter-city and inter-state motor truck terminals were visited, and although figures for densities were not available, loading times and methods were of interest. The use of fork-lift trucks and warehouse pallets was nearly universal for handling goods and for loading and unloading semi-trailers. Including the time required to check waybills and manifests, 20,000-25,000 lb of mixed cargo could be loaded at a warehouse dock on to a truck, or unloaded, in about one hour. Elimination of the detailed paper work reduced this to 30-40 minutes. By resorting to mechanization in one highly specialized parcel service, loading time had been reduced to seven minutes. "To be truly competitive with the truckers," said Mr. Middlewood, "it would appear that there is room for considerable improvement in this respect in aircraft design. A loading ramp such as provided on the C-130 design is an important step in the right direction, since it will permit fork-lift loading or mechanized loading from dock or ground level."

An opportunity was taken of visiting the Atlanta General Depot and Fort McPherson to examine the character of army cargo. Represented were the Third Army, the Signal Corps, Quartermaster Medical Corps, Ordnance and Engineers. With the exception of vehicles, vehicular equipment and replacements, cargo came in "rather uniform sizes and shapes." The bulk of tonnage was in sizes less than 8 cu ft per unit. It was rather dense, averaging about 25-40 lb/cu ft for rations and clothes; 35-50 lb/cu ft for fuel and lubricants; 20-30 lb/cu ft for ordnance and equipment; and 50-100 lb/cu ft for ammunition. With densities of this nature rather small aircraft cargo sections for a given payload could be used and permitted less "tin" per aircraft, with resulting higher efficiencies. Conversely, the C-130A responded efficiently to the "beef" treatment, particularly if the load factor were reduced to the civil level of 2.5. As a result, it would carry a very substantial tonnage increase in these particular types of military cargo.

Of the many problems to which answers were needed, one of the most important was the best approach, in a peace-time economy, to the proper development of a stand-by military capability. Consideration must be given to a civilian cargo movement by air as well



Seen here to advantage is the fairing for the fuselage-mounted, tandem-wheel, main undercarriage. This feature follows German practice, exemplified in Arado and Messerschmitt designs. Note also, in this view, the uncommonly fine field of vision obtainable from the cockpit.



On the left, a 5,000 U.S. gallon refuelling trailer is being backed into the C-130 mock-up during loading trials at Lockheed's Marietta plant. The right-hand picture shows an impressive cargo tie-down, but regrettably has little to give scale. Cargo volume is 40ft×10ft×9ft.

HERCULEAN TRANSPORT . . .

as the military logistics operation. History had shown that cargo had become the primary source of revenue in ocean, rail and highway transportation. There was every reason to believe that cargo transportation by air would exceed in revenue the passenger transportation in the relatively near future.

"The freight movement today," the speaker concluded, "is greatly increased over what it was in 1940. The railroads are hauling 50 per cent more volume. An expanded pipeline system, covering some 173,000 miles, now moves triple the tonnage of petroleum compared to pre-war figures. Freight on inland and coastal waterways is nearly double that of fifteen years ago. The increase in both passenger and freight transportation is the result of an expanded economy and the tremendous growth in the population of the United States. There are now 30,000,000 more of us than in 1940. The present movement of cargo by air is merely scratching the surface of a great potential market. The airplane manufacturer and the operator must together make this forward step and prepare to serve this market. Where the military and the civilian needs are so nearly parallel with regard to a cargo mobility, there is surely room for some overall consideration. The dual concept of a basic military/civilian cargo transport is an approach to a peace-time capability. The Lockheed C-130A is an airplane which puts us into the middle of this picture. It is an airplane which has the capability of future growth as required in handling its military missions. This same airplane has a growth potential in the cargo field which will offer to the logistics, or to the civilian operator, a direct operating cost of the order of 4 cents per ton mile as compared to present military cargo airplane costs of 6 cents per ton mile. We believe in cargo transportation by air and are determined to help further its case."

NEW BRITISH STANDARDS

THE British Standards Institution has recently published A.125-A.168, *Stiffnuts (UNF Threads for Aircraft)*, specifying dimensions, materials, testing and identification requirements for aircraft stiffnuts of ¼in nominal size and upwards, with Unified threads. These new standards consolidate in one series of documents the information previously contained in (a) Specification AD.114, published in 1942 by the R.A.E., which set out the design and test requirements for proprietary stiffnuts; (b) Ministry of Supply A.G.S. drawings, which provided common part numbers, maximum envelope dimensions and other features affecting interchangeability; and (c) individual manufacturers' drawings.

Preparation of the new standards afforded the B.S.I. the opportunity to co-ordinate the development of new series of nuts, the incorporation of which has resulted in a much more comprehensive standard than was previously possible. The aim throughout has been to define and dimension the product completely, so that the standards are adequate for manufacture and inspection; the only exception is the friction element, which is defined by the space it may occupy and the performance it must attain. Stiffnuts supplied to A.125-A.168 will, therefore, be interchangeable, one make with another, within the specified limiting conditions of temperature, etc. Copies of A.125-A.168 are obtainable at the British Standards Institution, 2 Park Street, London, W.1, price 10s 6d.

Another new British Standard is R.1 : 1954, the first of a series of specifications dealing with radio equipment for civil aircraft. It prescribes dimensions for radio units and associated racking, and standard forms of construction are specified in conjunction with methods of connection of plug and socket. The specification, which does not deal with performance requirements, is divided into five sections, dealing with rack-mounted units, rack mountings, subsidiary units, marking on units, and finishes. Copies are obtainable from the B.S.I. at 7s 6d.

Another newly published radio Standard is B.S. 2011, dealing with *Basic climatic and durability tests for components for radio and electronic equipment*. It describes conditions and procedure for climatic and durability testing of components for radio and allied electronic equipment which form the basis of the tests to be specified in the individual British Standards for the various types of components. Some of the tests detailed are accelerated or exaggerated in order to secure quickly information regarding liability to failure, whilst others are in the nature of exposure to actual conditions likely to be experienced in service. One feature of the standard is the introduction of a code indicating, in a simple way, the working temperature range and humidity classification of a component. B.S. 2011 is obtainable from the British Standards Institution at 5s.

RIVETING ALUMINIUM

A REVISED edition of *The Riveting of Aluminium* has been published (price 2s) by the Aluminium Development Association, 33 Grosvenor Street, London, W.1. Whereas the original edition, in 1944, dealt with rivets up to ¼in diameter and was largely concerned with aircraft practice, the new edition covers a considerably wider field of industry; nevertheless, the riveting of light-gauge light-alloy sheet, and other typically aeronautical applications, still forms a large part of this practical little handbook. Notes are given on the equipment required, preparations for riveting, rivet shapes, driving technique and the inspection of finished joints. Appendices include notes on the mechanical testing of rivets and on their heat treatment, together with tables of rivet ranges related to grip thickness and rivet diameter. The booklet is well illustrated with photographs and drawings.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

"War in the Air"

AS an aviation enthusiast I have for some months eagerly awaited the series of B.B.C. television films under the title *War in the Air*. Through the Press my appetite has been continually whetted by references to "tens of thousands of feet of film"—most of it not previously seen by the public in this country," "graphic action shots" and the rest.

But the realization of the dream—what an anti-climax! The introductory film of the pre-war years showed promise, and raised my hopes still further. Since then, however, things have gone steadily downhill. I appreciate the difficulties of film editing and the attempt made to avoid the disjointedness of the *Victory at Sea* series, but I feel that the compilers have sacrificed too much to the "plot"—in the instalment *Maximum Effort*, for instance, a considerable footage of film was wasted on such subjects as "Workers' Playtime," some German "Inkspots" and ground shots from the Eastern Front. Eventually we did get around to the Cologne raid, plus some night (?) shots of Stirlings taking off.

But why no pictures of some of the other stalwarts of Bomber Command at that date—the Hampdens and Whitleys—which, apart from a brief mention in the commentary, might never have existed? Yet these and the Wellingtons carried the brunt of the battle for months—and to good effect, too, in such attacks as the one on the Dortmund-Ems Canal, when Learoyd won his V.C.

Is there so little film of aerial activity available from these early years of the war? Certainly we were busy fighting for our very existence at this time, but surely more records were made of what was happening around us.

Tolworth, Surrey. T. N. SIMPSON.

The Dam-busters' Approach

IN *Flight* of November 26th, on page 782, there is a mention of the method used on the Lancasters of No. 617 Squadron for checking their approach height over the water, by means of light beams directed downwards to converge at 150ft.

I think this should read "60ft." I believe it was an idea of Sir Ben Lockspeiser's.

Wallingford, Berks. M. SPIERS.

[According to W/C. Guy Gibson's account, 150ft approach was employed during the initial trials: it was then found that 60ft was practicable, and this altitude was used for the actual operation.—Ed.]

"Non-playing Members"

A COPY of *Flight* takes eight weeks or more to get out here, but might I comment on your leading article with the above title in your issue of July 30th?

I would question the accuracy of your guess that "three-quarters of the R.A.F. ground crew would give their eye-teeth to fly as pilots." I have been associated with aircraft maintenance (R.A.F., Civil, R.N., and now R.A.N.), since 1932, and I would put the figure at nearer 5 per cent than 75 per cent.

There are two main types of individual attracted to the operational side of aviation—the bird man and the ground man. The first is mad keen to fly anything, anywhere, any time. The second, who is much more numerous, is technically interested in aircraft as flying machines but has little desire to fly them, or in many cases to fly *in* them. The pleasure of making a fine mechanism function perfectly is at once his inducement and his reward.

Not being a psychologist, I cannot give any reasons for these attitudes of mind; but I do know that it is very difficult to get candidates for aircrew; and, so far as gliding on Service establishments is concerned, the last time a gliding club was proposed on my air station the response was not 75 per cent but 2 per cent.

This letter, of course, expresses a purely personal point of view and must not be taken as reflecting the official attitude of the Royal Australian Navy.

N.S.W., Australia. G. I. FINKEL,
Lieutenant Commander (E)., R.A.N.

Britannia Progress

ON page 728 of your November 19th issue, in the caption to the photograph showing Britannia assembly at Filton, you state that the Britannias are "still short of engines . . ." This is not so. Production of Proteus engines is in fact considerably in advance of airframe requirements; we are, indeed, stock-piling engines.

You also state that the Britannia is short of pressurized flying hours. This can only be accepted as true if it is related to the need for extended pressurized flying as recently established from the Comet Inquiry. On the basis of requirements existing up to the time of the Comet Inquiry, the Britannia had in fact done a greater proportion of pressurized flying, relative to its total development flying life, than has, I believe I am right in saying, any other airliner.

We are now engaged on an intensive flying programme in which B.O.A.C. crews are participating in order to complete upwards of 2,000 hours' flying by the time the C. of A. for the aircraft is obtained.

Filton, Bristol. C. B. BAILEY-WATSON,
Public Relations Manager, Bristol Aeroplane Co., Ltd.

The R.E.8

THE authoritative letter on the R.E.8 in the issue of *Flight* for November 26th is just the sort of contribution to air history that is so valuable. Rarely do we get a true picture of past events, particularly of periods so colourful as 1914-1918. This is especially true of memories of handling characteristics, and W/C. Yeatman has put his finger on most of the peculiarities of the R.E.8, including the illusion, caused by the great air-scoop "forrard," of acute tail-down attitude. The test pilot who flew many more hours than any other in the type told me he attributed most of the "tyro" accidents to this feature, which led to the fast landings referred to by W/C. Yeatman and to stalls on take-off.

As regards the lack of power, it was unfortunate that the development of the engine, the R.A.F. 4 d, with its aluminium cylinders and much better power/weight ratio, was not proceeded with, because of Air Board action prompted by the report of the Parliamentary Committee which "judged" the Factory and stopped all design development, particularly of engines. If an exception had been made in this case, the Squadrons using the R.E.8 in 1918 would have had a much more comfortable time, but it is easy to be wise after events.

The design team responsible for the R.E.8 was led by S. W. Hiscocks, then assistant chief engineer at the Factory. He afterwards became general manager, under G. Holt Thomas, of the Aircraft Manufacturing Company at Hendon and thus was responsible for the production of the early D.H. types. The last I heard of him was that he was farming in Sussex.

Woking, Surrey. C. F. ANDREWS.

FORTHCOMING EVENTS

Dec. 10. International Federation of Air Line Pilots' Association: Technical meeting on airborne radar.
Dec. 10. Helicopter Association: "Possibility of the Flight Simulator as a Training Aid to Helicopter Pilots"—informal discussion, to be opened by Norman Hill.
Dec. 10. Women's Engineering Society: Members' evening.
Dec. 11. British Interplanetary Society: "The Planet Mars," by P. Moore, F.R.A.S.
Dec. 11. British Interplanetary Society (Midlands branch): "Civil Engineering on Other Worlds," by M. S. Wright, B.Eng.
Dec. 14. Institute of Transport Metropolitan Graduate and Student Society: "Modern Navigational Aids in Ships and Aircraft," by C. Powell.
Dec. 16. Institute of Metals: "Melting and Casting under Reduced Pressure," by Dr. H. H. Scholefield, Ph.D.
Dec. 16. R.Ae.S. 10th British Commonwealth and Empire Lecture.
Dec. 17. Institute of Navigation: "The Accuracy of Dead Reckoning in Air Navigation," by C. S. Durst, O.B.E.
Dec. 17. Institute of the Aeronautical Sciences: 18th Wright Brothers Lecture, by Bo Lundberg.
Dec. 18. British Interplanetary Society (North-west branch): "Debris in Space," by E. Burgess, F.R.A.S.
Dec. 19. British Interplanetary Society (provisional Yorkshire branch): "Living in Space," by M. S. Wright, B.Eng.
Dec. 20. Institute of the Aeronautical Sciences: 18th Wright Brothers Lecture (repeat), Los Angeles, U.S.A.
Dec. 20. Institute of Transport: Annual general meeting.
Dec. 21. R.Ae.S. Section Lecture: "Free Tab Control," by Dr. W. J. Strang, A.F.R.Ae.S.
Dec. 22. Institute of the Aeronautical Sciences: 18th Wright Brothers Lecture (repeat), Cleveland, U.S.A.
Jan. 4. R.Ae.S. Section Lecture: "Recent Advances in the Knowledge of Transonic Airflow," by C. H. E. Warren, M.A., A.F.R.Ae.S.
Jan. 6. R.Ae.S. Main Lecture: Lecture to young people, by P. G. Masefield, M.A.(Eng.), F.I.A.S., F.R.Ae.S.
Jan. 8. British Interplanetary Society: "Using Hydrogen Peroxide," by A. V. Cleaver, F.R.Ae.S., and "Liquid Oxygen as a Rocket Propellant," by S. Allen, M.I.Mech.E., A.F.R.Ae.S.
Jan. 8. British Interplanetary Society (Midlands branch) "Spectroscopy in Astronautics," by W. H. T. Davison, M.A.

R.Ae.S. Branch Fixtures (to Jan. 6)—
Dec. 10, *Bristol*, Christmas Ball (jointly with Inst.C.E., Inst.Mech.E., and Inst.S.E.
Dec. 14, *Belfast*, debate: "Modern Aircraft are Unnecessarily Complicated."
Jan. 3, *Belfast*, "Model Making," by T. Gowan. Jan. 5, *Luton*, Junior Night. Jan. 6, *I.O.W.*, "Case for the Light Fighter," by P. A. Norman.

G.A.P.A.N.'s Twenty-fifth Anniversary

The Duke of Edinburgh, as Grand Master, Speaks at County Hall Ceremony

ONE of London's noblest buildings—the County Hall—was, on November 30th, the setting for a ceremony to mark the 25th anniversary of the foundation of the Guild of Air Pilots and Air Navigators of the British Empire. As Grand Master, His Royal Highness the Duke of Edinburgh, K.G., presided, and on the same occasion, the new Master, Capt. J. C. Harrington, O.B.E., F.R.G.S., was installed. Capt. Harrington is Deputy Operations Director (Operations) of B.O.A.C.

In his speech the Grand Master said that since the last Installation Ceremony the Queen and he had travelled "quite a long way." He recalled that they had used almost every form of transport known to man, and that they travelled a great many miles by air. "In fact," said the Duke, "we could not possibly have seen and learned as much as we did without the use of aircraft." He was particularly pleased, he said, to have the chance to meet and talk to the pilots and navigators who flew the Royal Party on so many occasions. Wherever they were, he found them full of enthusiasm for their profession and utterly convinced of the importance of aviation to the future of their countries.

"Turning now to the affairs of our Guild," the Grand Master went on, "I am delighted to hear that membership is steadily increasing and that we can count among our members many of the most distinguished names in the aeronautical profession, and, perhaps even more important, senior active airline pilots. The Guild seeks to look after the interests of pilots and navigators, and to do this we must have the help and support of those who have risen to the top of their profession. I am sure that all members and everyone interested in civil aviation were most gratified that one of our Wardens took part in the Remembrance Day ceremony this year and laid a wreath on the Cenotaph. This is a slightly belated, but none the less welcome recognition of the valuable and gallant services of civilian airmen in war.

"While recognizing that other bodies are concerned with the material aspects of professional pilots, this Guild continues to concern itself with the general well-being of all those who practise the art of air pilot and air navigator. It is therefore quite obviously one of the Guild's most important functions to see that entry into the lifetime profession of pilot is arranged to the best advantage of the profession and to the increasing numbers of people who rely upon their skill and judgment. Equally, as the Guild is concerned with the dignity and status of the aeronautical profession, it must see to it that any member of the profession or of this Guild who by word or deed brings the good name of the Guild or profession into disrepute is effectively restrained. It is just as important to discourage misbehaviour as to recognize merit, although I hope the former will never arise."

Having thanked His Royal Highness for giving his valuable time in a busy life to be with the Guild that evening, the new Master went on to refer to the 25th anniversary of the Guild's foundation. The pioneers, he said, had set the standards, and the Guild was proud to have some of them as Wardens on the platform that evening. Having described the activities of the Guild, including the various committees and the education fund, the Master made reference to the newly formed Parliamentary Committee, aimed at the two-way supply of information on aviation matters between the Court and Members of both Houses of Parliament while preserving complete political impartiality. The Court felt that they had a grave responsibility in making representations to responsible Ministers or the Press on air matters which it was felt needed expression. The Guild, said the Master, could look back on a year in which steady, though not spectacular, progress had been made.

The installation ceremony being concluded, the Grand Master bestowed the Guild trophies. The Johnston Memorial Trophy, awarded for the best feat of air navigation in 1953, was received by Capt. M. J. R. Alderson, O.B.E., B.A., on behalf of the pilots and navigators of B.O.A.C.'s Comet Fleet. The Cumberbatch Trophy, for the best record of reliability for the year, was handed to Sir Miles Thomas, D.F.C., M.I.Mech.E., M.S.A.E. (on behalf of British West Indian Airways, Ltd.), and the recipient of the Derry and Richards Memorial Medal, for the best achievement in experimental flying, was the wife of W/C. J. H. Heyworth, A.F.C. (W/C. Heyworth himself being in South America). This last award was made "for research work in jet-engine development." There was no award this year of the Brackley Memorial Trophy—for the best achievement in the operation of flying boats.

The conversazione which followed the bestowal of the trophies was among the most pleasant, and best-attended of the whole aeronautical year. In the course of the evening a portrait of the Grand Master—the work of Mr. S. Morse-Brown—was unveiled by the newly installed Master. A reproduction appears on an earlier page.

On the day preceding the ceremony at the County Hall, fifteen of the available founder-members of the Guild sat down to dinner at Rules restaurant where, a quarter of a century before, the idea of the Guild had been born. Those present were: Capt. G. Birkett; Capt. N. W. G. Blackburn; G/C. P. W. S. Bulman, C.B.E., M.C., A.F.C.; W/C. J. C. Cantrill; Major J. L. B. H. Cordes, F.R.S.A., A.F.R.Ae.S.; Capt. O. P. Jones, C.V.O., O.B.E., F.R.G.S., A.F.R.Ae.S.; W/C. W. R. Parkhouse; W/C. C. A. Pike, O.B.E., A.F.C., A.F.R.Ae.S.; W/C. R. C. Preston, A.F.C.; W/C. R. H. Stocken, F.R.Ae.S.; Sir Frederick Tymms, K.C.I.E., M.C.; Capt. A. S. Wilcockson, O.B.E.; Mr. L. A. Wingfield, M.C., D.F.C. (hon. member); W/C. N. Macmillan, M.C., A.F.C., D.L. Guest of the founder-members for the evening was the new Master, Capt. J. C. Harrington, O.B.E., F.R.G.S.

BOMBER OFFENSIVE ON TV

EPISODE 4 of the B.B.C. Television film *War in the Air* did not, as its title *Maximum Effort* might suggest, portray the maximum-strength raids made towards the end of the war. Instead, it covered the early build-up of Bomber Command and the title signified the maximum bomber effort that could be mounted nightly; in the summer of 1941 this was around 60 aircraft. The bulk of these were Wellingtons which, in the words of the commentary, "dare not fly by day." Thus they did most of their work at night, finding their targets unescorted and with only elementary radio aids to guide them. The shots of a Wimpey being serviced and bombed-up will have brought back many memories of those who served in and with these aircraft.

From then onwards the pace of the film increased. First came yet more shots of Ju 87s, this time attacking targets in Yugoslavia, and brief mention was made of the nine British Squadrons (diverted from North Africa) posted to help in the Balkans; but their contribution to slowing the advance, before the 46 surviving aircraft were withdrawn, was not covered.

After Greece came the mighty land attack on Russia, backed up by four separate Luftwaffe air forces. Shots of these in action included gaily decorated Me 110s taking off and He 111s dropping bombs. Mention was made of the Hurricane Wing that went to Russia, and of great interest were shots of Russian aircraft in action. These included Il-2s (Stormoviks) and DB-4s attacking German ground forces, DB-4s being straffed and I-15 (Chato) biplanes attacking the Germans in the air. Other Russian sequences showed Ju 52s being loaded from sleighs and an Me 109 being manhandled in snow. The Russian scene ended with the Red Star being stencilled on a Spitfire prior to its delivery to the Eastern Front.

The last half of the film continued the story of Britain's growing bomber offensive. Britain at this time was making weapons of a kind that Hitler lacked—four-engined bombers, the Stirlings, Halifaxes and Lancasters. Stirlings were shown in various stages of construction, as was the all-wood Mosquito, the importance of its daylight-reconnaissance rôle being stressed.

By the spring of 1942 Bomber Command could call upon 600 operational aircraft, of which 100 were four-engined heavies. Nearly 50 per cent of this force was equipped with the new navigational aid Gee, which provided an accurate means of navigating to targets through darkness and cloud.

On May 30 came the first of the 1,000-bomber raids. For this operation an extra 400 aircraft were organized. Fifty were borrowed from Army Co-operation, and the force included Ansons, Blenheims, Hampdens, Manchesters, Stirlings, Halifaxes and Wellingtons. The sequence leading up to this raid gave a good insight into the immense amount of planning required to get such a force into the air and over its target—Cologne—in 90 minutes. Shots from captured German film showing their civil defence, raid plotters, people in shelters, the city burning, damage being repaired and civilians evacuated and acres of ruin (taken, surely, after the war?), provided an appropriate climax. M.F.A.

"Flight" photographs

Three commanding officers: S/L. S. Bradford, D.F.C., W/C. G. O. Newstead and S/L. W. C. Horsman, D.F.C. On the right twelve D.H. Vampire 9s of the Wing pass over the saluting base.

No. 78 WING RETURNS HOME

AFTER having served in Malta for the past two years and five months as part of Middle East Air Force, No. 78 Fighter Wing, Royal Australian Air Force, is returning home. The Wing's operational squadrons are Nos. 75 and 76, which have been flying Vampire 9s hired from the Royal Air Force. (For this hire a figure of £92 per flying hour has been unofficially mentioned.)

On Wednesday of last week a farewell parade was held on the airfield at Ta-Kali, where the Wing has been stationed. The salute was taken by His Excellency the Governor and Commander-in-Chief, Sir Robert Laycock, K.C.M.G., C.B., D.S.O.

The parade took the familiar form of an inspection and march past, the standard of drill being very high. Addressing the Wing, the Governor rendered thanks and good wishes on behalf of all the people of the Island. He congratulated them on doing so well at sport—they were unbeaten at cricket during the whole of their stay on the Island. The Governor also expressed regret that Air Marshal B. V. Reynolds, A.O.C., H.Q. Malta, was unable, through indisposition, to be present.

Air Marshal Sir Donald Hardman, K.C.B., O.B.E., D.F.C., Air Member for Supply and Organization, who represented the Air Council, also addressed the parade. He reminded his audience that he had watched them march through Sydney in July 1952 when on their way to Malta. (Sir Donald was then Chief of the Air Staff of the R.A.A.F.) He went on to say:—

"On behalf of the Air Council, I would like to express their gratitude to you for what you have done for the R.A.F. in the wider sphere. By your presence in the Middle East during two critical years there is no doubt you have made a most valuable contribution towards the maintenance of stability in the whole Mediterranean area. It would not have been easy to find a force which could have done this in your place, and certainly none could have done it with more distinction. It is clear from reading the record of your many exercises, detachments, visits and fly-pasts—including the Odiham Review last year, and the large exercises in Europe and the Mediterranean—that you have lived up to all the highest traditions of the Royal Australian Air Force. Your winning of the coveted Imshi-Mason Trophy deserves special mention and shows literally that the standard of flying and gunnery in the Wing has been second to none. I see that many of you have gained your skill the hard way in Korea."

At the close of the ceremony the Wing made a stream take-off preparatory to flying past the daïs in salute to the Governor. While the two squadrons were starting up and getting airborne an excellent show of individual aerobatics was put on by F/L. L. Reading, D.F.C. His low slow rolls were quite remarkable.

The two officers who have commanded the Wing during its stay in Malta both served in the war and with No. 77 Squadron, R.A.A.F., in Korea. G/C. Brian Eaton won the D.S.O. and Bar and D.F.C. while commanding a fighter-bomber wing in the Desert Air Force, and W/C. G. O. Newstead, who took over command last September, flew on operations from 1941 to 1945 in the Dutch East Indies, Darwin and New Guinea.

When the units finally break up and return to Australia, S/L. W. C. Horsman, D.F.C., who commands No. 75 Squadron, is to come to the R.A.F. Staff College and S/L. S. Bradford, D.F.C., the C.O. of No. 76 Squadron, expects to be posted to a Sabre base.

Sir Robert Laycock inspects the parade and takes the salute. With him on the daïs are Air Marshal Sir Donald Hardman; Air Marshal Sir Claude Pelly, A.O.C-in-C. M.E.A.F.; A. Cdre. A. M. Charlesworth, R.A.A.F., A.O.C. Overseas H.Q.; and G/C. E. J. P. Davy, Deputy A.O.C. Air H.Q., Malta.

"Flight" photographs

Viscounts in production at Vickers-Armstrongs' Hurn factory, which is scheduled to turn out 55 of these aircraft next year. In the foreground, almost complete, is T.A.A.'s fourth Viscount; behind it are four more aircraft approaching completion, headed by the second for T.C.A.

CIVIL AVIATION

HELIPORTS ON BRIDGES?

MANY suggested solutions to the problems involved in providing city heliports—or, as the M.T.C.A. calls them, airstops—are put forward from time to time. Some are frankly fantastic, some are mechanically practical but would prove prohibitive in cost, and a few are worthy of serious study.

Though to pass a considered judgment would demand lengthy investigation, one suggestion recently put forward seems on brief examination to offer possibilities. An ex-R.A.F. Londoner, Mr. L. C. Hall, sends details of a scheme by which he seeks to solve major difficulties which he lists as follows:

Ground sites: high price or rental of ground; obstruction and air turbulence caused by surrounding buildings, producing different conditions in every city and calling for varied approach techniques in each case; noise nuisance; confusion caused to pilots by the shadows of buildings, varying at each hour of the day. *Roof-top sites:* structural unsuitability of most existing buildings for the purpose; difficulty of identification and approach during and after dusk, with the possibility of street lighting adding to the confusion.

Mr. Hall's suggested solution—which he has worked out in considerable detail, even to the extent of building scale models—is that platforms, oval in shape, should be built partially over the river-bank ends of existing rail or road bridges. One end of the platform would be carried on piers based on the ground on either side of the bridge approach; the other would be supported on columns surmounting the first set of approach piers over the water.

As applied to Hungerford Bridge, which Mr. Hall considers would be an ideal site for the central London heliport, the platform would be situated some 140ft above the mean river level. It would measure about 420ft by 200ft and would be surrounded by a 7ft baffle wall to minimize noise; against the wall, at the least-used ends, would be small light-alloy buildings. Fuel and fire-extinguisher tanks would be slung below the platform, while a lift like that of an aircraft carrier would lower any unserviceable helicopter to ground level. Covered alley-ways and stairways would provide access to the platform from ground level.

Obviously, bridges used for this purpose would have to be of sufficiently robust construction to carry the weight of the platform, which might ultimately have to accept far heavier helicopters than those likely to be in use initially. In the House of Commons on November 17th, Lt.-Col. Lipton (Lab., Brixton) asked the Minister of Transport and Civil Aviation what consideration had been given to the erection of helicopter landing sites over Blackfriars and Hungerford bridges. Mr. Boyd-Carpenter replied that neither bridge could bear the weight of a helicopter platform, which would therefore have to stand on an independent structure. This would be expensive and might also obstruct navigation.

This official pronouncement must have proved disappointing to Mr. Hall; nevertheless, we are still inclined to feel that his idea has possibilities, particularly as the piers supporting the platform could probably be arranged to straddle the bridge, thus relieving it of weight. The river-approach aspect of the scheme is a strong point in its favour.

THE SHANNON INQUIRY

EVIDENCE by members of the crew and by airport officials was given during the first week of the public inquiry into the accident to K.L.M. Super Constellation *Triton* after take-off from Shannon on September 5th. President of the Inquiry, which began in Dublin on November 29th, is Mr. Justice Teevan: his four assessors are Mr. J. Marx, chief aeronautical engineer to the National Aeronautical Research Institute, Amsterdam; Capt. G. K. Edward, assistant director of flight operations, Trans-Canada Air Lines; Mr. E. V. P. Miller, divisional air traffic control officer, M.T.C.A.; and Commandant Andrew O'Shea, assistant aeronautical engineer, Irish Air Corps.

Mr. Sean McBride, S.C., in his opening speech for the Attorney-General of the Irish Republic, submitted that the evidence should be considered under three headings: Firstly, to find the cause of the crash; secondly, to find the cause of the petrol fumes in the passenger cabin; and thirdly, to find the reasons for the unawareness of the crash and the apparent delay in rescue operations.

The captain of the aircraft, Capt. Adrian Viruly, said that during the take-off, on Runway 14, he heard a "peculiar noise" from one of the port engines. After take-off, following the retraction of the flaps during the climb, at an airspeed of 160-165 kt, he had the impression that "something was entirely wrong with the aeroplane"; he noticed the rate-of-descent indicator showing more than 1,000 ft/min; and immediately afterwards the impact occurred.

Other crew-members gave their accounts of the accident and subsequent rescue operations, and the evidence of airport eye-witnesses of the take-off and rescue was given.

I.A.T.A. HELICOPTER MEETING DECISIONS

ANY attempt to decide the characteristics of future transport helicopters must be preceded by a realistic determination of the size and location of the city heliports they are to use. This conclusion was stated following the first session of the I.A.T.A. Helicopter Working Group which met in Montreal last month.

Captain Anselme Vernieuwe, the chairman of the group and vice-president of Sabena, said "While we all feel we shall want helicopters carrying about the same number of passengers as the average autobus, we must tailor the performance specification to fit the limited space inside the cities we hope to serve." This decision, he said, marked a radical departure from the traditional course of fixed-wing development.

Other major principles accepted by the group were: (1) "Helicopter problems are of interest to all airlines even though they may never intend to use them, if only because they must share the same air space in terminal areas. (2) The helicopter must be given a chance of development on the basis of design capabilities as we know them now and as experience will reveal them further. (3) The helicopter must not be fettered by confinement to the limitations of fixed-wing aircraft; we must not accept fixed-wing answers to helicopter questions. (4) Regulation of helicopter operations should not become rigidly fixed before experience proves the need for regulation and the most desirable ways of applying it."

Separate groups of European and North American operators have started work on the related questions of heliport size and location and performance requirements, and have instructions to co-ordinate their work so that comparable recommendations can be brought before the main group's next meeting in Brussels in February next year. Forecasts of the desirable size and economic characteristics of future helicopters, based upon their individual routes, are also being prepared for the Brussels meeting.

INDEPENDENT ASSEMBLY

AT the annual meeting of the British Independent Air Transport Association, held in London on December 8th, Mr. M. H. Curtis, managing director of Hunting-Clan Air Transport, Ltd., took over from A. Cdre. G. J. Powell as the association's chairman for 1954-55. Reviewing the past year, A. Cdre. Powell noted that the independent operators had continued to endeavour to

Lufthansa took delivery of their first post-war aircraft—two Convair 340s—on November 29th. One is shown here on arrival at Hamburg. Subject to ratification of the Paris agreements, the airline hopes to introduce Convairs next spring on routes to Paris, London, Rome and Cairo.

develop their business wherever possible in the restricted fields of opportunity open to them. Those opportunities were essentially of a low-revenue nature and generally did not ensure sufficient stability to provide operators with firm foundations on which to make forward plans along sound commercial lines. It was B.I.A.T.A.'s considered opinion, said A. Cdre. Powell, that a review of the 1952 Government policy was essential, not only to establish the position of the independents on a more sound basis, but to accelerate the overall expansion of the industry.

The association was now playing an increasingly important role in all negotiations affecting the industry, and much assistance had come from the increased membership over the last year, which had made B.I.A.T.A. totally representative of the independent airlines.

VIKINGS TO THE NORTH

FROM December 17th, 34-seat Vikings will replace Dakotas on all of Hunting-Clan's continental services from Newcastle, Glasgow and Manchester. The inaugural Viking service from Newcastle to Stavanger and Oslo took place on December 1st; other inaugural dates for the Viking services are December 3rd (Glasgow-Newcastle-Paris), December 16th (Manchester-Newcastle-Hamburg-Copenhagen) and December 10th (Newcastle-Amsterdam-Dusseldorf). From December 13th, the daily London-Newcastle service will also be operated mainly with Vikings.

Hunting-Clan now have five Viscounts on order, of which three will be delivered early in 1955. It is hoped that development of the airport facilities at Woolsington, Newcastle, will be such as to permit the introduction of Viscounts on the northern network by the summer of next year.

BREVITIES

FIGURES published by the C.A.B. show that aircraft operated by individuals or companies in the United States for business purposes flew 3,626,000 hours last year—430,000 hr more than the total logged by scheduled domestic and international airlines. Pleasure flying hours totalled 1,846,000, showing the first increase since 1949, but instructional flying dropped by 17 per cent.

* * *

The chief engineer of Capital Airlines, Mr. Ian Caldwell, has been appointed liaison officer in Britain during the period of delivery of Capital's 60 Viscounts. Now based at Weybridge, he is expected to remain for about two years.

Until recently stationed at B.E.A.'s head office as assistant to the chief executive, Mr. G. W. H. Wharton has taken up a new appointment in New York as the Corporation's sales manager for North America. During his war service with the Royal Engineers, Mr. Wharton played a major rôle in four Allied landings—in North Africa, Sicily, Salerno and Normandy, where he was port commandant of the Mulberry Harbour. He joined B.E.A. in 1946, later becoming responsible, as charter superintendent, for planning the British civil contribution to the Berlin airlift.

* * *

In conjunction with three New York travel agencies, B.O.A.C. are offering a series of round-the-world inclusive tours. The rates, based on fares from New York, vary from £780 (tourist) for a 24-day tour to £1,426 (first-class) for the 58-day "Southern Cross" tour, which is concentrated particularly on Australasia.

* * *

Throughout this year a "paper jet" operation involving a simulated crossing of the North Atlantic has been carried out every few days in the K.L.M. headquarters at Schipol. Like the similar exercise conducted by B.O.A.C., these operations are designed to build up theoretical knowledge by relating jet-airliner performance to problems of weather, navigation and flight-planning.

* * *

In *Information Circular* No. 154/1954, the M.T.C.A. states that it is hoped that V.O.R. will be available on all U.K. airways by 1958. A detailed programme for phasing-in ground and airborne installations is to be drawn up by the Ministry in collaboration with all interested parties.

* * *

Pilots making V.F.R. flights have been strongly advised by the M.T.C.A. (in *Information Circular* No. 140/1954) to maintain at least 1,000ft vertical clearance from cloud whenever possible. The recommendation is inspired by the steep climb/descent angles of modern military aircraft, whose pilots, on breaking through cloud, may have very little time in which to avoid an aircraft 500ft above or below them.

* * *

It is reported from Bombay that, following Mr. Nehru's visit to Peking in October, the Indian and Chinese People's Governments have agreed in principle to the operation of reciprocal services between the two countries. Details of the agreement have yet to be worked out. It is proposed that Air-India's present Super Constellation service to Hong Kong should be extended to Canton. Negotiations for a similar service from India to Tokyo, which began some months ago, do not yet appear to have reached a conclusion.

* * *

Four B.O.A.C. captains have been based in Sydney to enable duty hours on the eastern section of the London-Sydney route to be reduced. The recently published inquiry into the Kallang accident showed that the captain concerned had been on duty for 21½ hr between leaving Sydney and arriving at Singapore. The Sydney-Darwin and Darwin-Singapore sections are now flown by separate captains.

A comparatively recent use for helicopters is the provision of air ferries between shore stations and oil companies' drilling barges off the coast of Texas. This Bell 47G is one of two used for such work by Hawk Helicopters of Corpus Christi.

CIVIL AVIATION . . .

Recent tests in Africa showed the freighter version of the Nord 2501 Noratlas to be capable of lifting six tons of cargo over 720 miles at 208 m.p.h. The aircraft carried two Turboméca Marbore 880-lb thrust auxiliary turbojets in wing-tip mountings, which, according to a French source, gave the Noratlas "the sureness and suppleness of a four-engine aircraft." It is also announced that two Noratlas freighters have been acquired by the independent airline U.A.T.

* * *

The ABC World Airways Guide is among the publications compiled and printed by Index Publishers, Ltd., of Dunstable, an old-established company whose share capital has just been acquired by Associated Iliffe Press, Ltd. The guide is owned and published by Thomas Skinner and Co. (Publishers), Ltd., one of the companies of the Kelly-Iliffe group. Mr. C. E. Wallis, chairman of Associated Iliffe Press, has been appointed chairman of Index Publishers, Ltd.

As the markings on its fuselage proclaim, this Lockheed Electra played a part in a recent Australian car trial, carrying officials to control points in advance of competitors. It is normally used as an executive aircraft by Christey's Motor Auctions—hence the registration VH-CMA.

CLUB AND GLIDING NEWS

FIRST annual dinner and dance of the Surrey Flying Club, a most enjoyable and successful occasion, took place at the Aerodrome Hotel, Croydon, on Friday, November 26th. In the absence of the club's chairman, Mr. C. A. Nepean Bishop, the health of the guests was proposed by the C.F.I., Mr. Alan Sproxton. The award of the Harris Trophy was made to one of the younger club members, Miss Anne Briggs (who had obtained top marks in a cross-country navigation exercise), by Mr. Duncan Lush, the club's vice-president. Donor of the trophy was 81-year-old Mr. Sam Harris, who first presented it to the Redhill club in 1947. As briefly recorded in *Flight* of October 29th, the club has made good progress in its first season since (as the Redhill Flying Club) it was forced to cease operations at Redhill and start again at Croydon. Having successfully overcome the major setback involved in this move, the club is now gaining new members and progressing steadily—a reflection of the enthusiasm of both staff and club members. Maintenance of the club's fleet is carried out at Croydon by Rollasons on a flying-hours basis, and plans have been made for the provision of a new clubhouse.

AS mentioned on page 825, the welcome announcement of the abolition of landing fees for club aircraft at M.T.C.A. aerodromes was made by Mr. John Boyd-Carpenter, Minister of Transport and Civil Aviation, on Friday last, December 3rd. Proposing the health of the Association of British Aero Clubs and Centres at its annual dinner at the Waldorf Hotel, London, Mr. Boyd-Carpenter said that the A.B.A.C. was continuing to do a first-class job in the national interest. A total of 1,200 A.T.C. and C.C.F. cadets had obtained P.P.L.s at the clubs; while 14 companies had taken advantage of the Firms' Flying Clubs Scheme, it remained a pity that more of the larger firms in the aircraft industry had not followed this example. After announcing that M.T.C.A. landing fees for club aircraft were to be abolished in future, the Minister described this step as "an indication of the high value we place on the movement you represent."

Sir Lionel F. Heald, Q.C., M.P., vice-president of the Association and chairman for the evening, replied for the A.B.A.C. After paying a tribute to the qualities of the Fair Oaks Club, which was in his constituency, and of its veteran C.F.I., W/C. Arthur, he expressed the gratitude of those present for the handsome way the question of landing fees had been dealt with by the Minister. The Association, he said, was proud of the progress made in the A.T.C. scholarships scheme, and they hoped that something might be done in reducing the number of documents required by those who flew abroad. The flying clubs were doing a splendid job in maintaining the airmindedness of the country, and they performed a valuable function in keeping a bond between those who understood the air and those who did not.

Proposing the health of the guests, Mr. G. H. M. "Eustace" Miles, O.B.E., (chairman of the A.B.A.C.) pointed out that a wider cross-section of the aviation community was present that evening than on previous occasions. The association was grateful for the continued co-operation of the M.T.C.A. and the Air Ministry, and was pleased to welcome L'Abbé Amiard, representing the French Fédération Nationale Aéronautique. The association's aim was for its members to be good neighbours in the community of aviation, and co-operation with other nations was welcomed.

Air Chief Marshal Sir Francis J. Fogarty, K.C.B., K.B.E., D.F.C., A.F.C., Air Member for Personnel, who responded for the guests, mentioned the good results being obtained from the Cadets' flying scholarships and air experience schemes.

In a warm, friendly and amusing speech, Abbé Amiard conveyed the greetings of all the French Aero Clubs—and especially of his own club at Flers, Normandy—and extended a welcome to all those present to visit the French clubs. The Abbé himself was at present building a Jodel two-seater which should be ready to fly next February and which, with the assistance of the French government, would cost only £100. He concluded "I invite all of you to come over to Flers next Summer. You will see my Jodel. You will see me. And you will see something else which I will not tell you, but which you will taste on the spot."

Final event of the evening was the presentation of the Lennox-Boyd Trophy for the "most efficient club," which this year was adjudged to be the Elstree Flying Club, with 68.94 per cent of the available points. C.F.I. David Ogilvy received the cup from Mr. Boyd-Carpenter. In second and third places respectively were the Wolverhampton Aero Club (67.75 per cent) and the West London Aero Club (66.93 per cent).

SOME 200 members and guests attended the Yorkshire Aeroplane Club's annual ball at Harrogate on November 26th. During the evening the R. H. Braime Navigation Trophy, awarded on a handicap basis for the best performance over a 100-mile circuit, was presented jointly to Mr. John Hardy and Mr. Malcolm Coulson (with co-pilot Brian Elliott). The Club's fleet is being increased by the addition of an Aiglet Trainer.

JANUARY 8th is the date of the Southern Aero Club's "Christmas and New Year" Party at Shoreham. The occasion will be particularly significant as it will combine a celebration of the 17,000th hour flown by the club's veteran C.F.I., Mr. C. L. Pashley, M.B.E., A.F.C.

ONCE again, the Surrey Gliding Club (according to their *Lasham Newsletter*) are "defying the Lord Chamberlain, the B.G.A. Council and a certain hill club by holding our annual (very hardy) Christmas Party." Due to happen tomorrow, December 11th, the affair will be "same as last year with the notable exception that the scriptwriters who wrote last year's play have been shot . . . However, the grog is good, the company excellent . . ." On the list of forthcoming events is a visit by Laurence Wright to show his colour film of this year's "Winternationals."

Among the topics discussed in the Newsletter is the question of whether Lasham should or could be the site for next year's National championships. The result of a recently circulated questionnaire showed a strong majority of club members in favour of the suggestion, but finance, naturally, is stated to be the one dominating factor. Also suggested is the setting-aside of money by clubs or the B.G.A. to subsidize flying and training for potential entrants for International contests.

A newcomer to Lasham is Bill Gotch, a Silver "C" pilot recently with the Bristol Club, who has now become club manager to the Surrey Club. With the Army club's Prefect sold, and the Grunau expected to go soon after Christmas, conversion in future will be from T-21B two-seater direct to Olympias. Work on the new alteration and improvement scheme for the Lasham clubhouse has started.

ANNUAL general meeting of the R.A.F. Gliding and Soaring Association will be held on Friday, January 21st, at 1500 hr in Londonderry House, 19 Park Lane, London, W.1. Air Commodore G. J. C. Paul, D.F.C., chairman of the association, tells us that all serving members of the R.A.F. and W.R.A.F. who are interested in gliding will be welcome.

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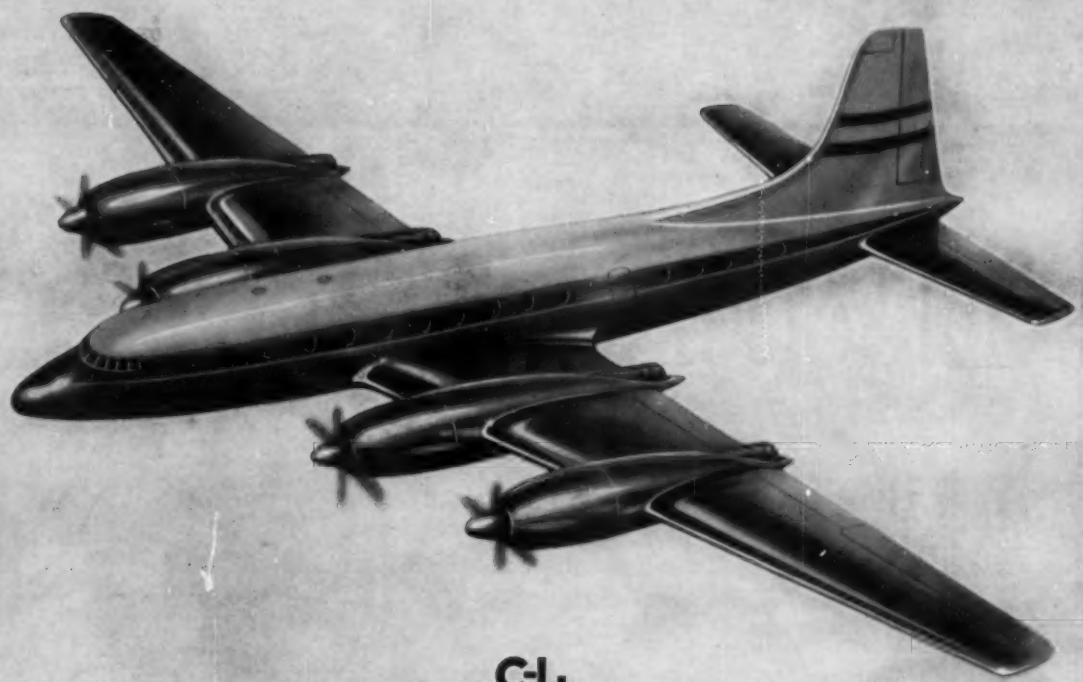

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SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

THE FUTURE OF THE FORCES

IN the Commons debate on the Queen's speech, Members were given a preview of a number of changes in the structure of the three Services. For details, however, they must wait until the Estimates are presented next year.

The Minister of Defence, Mr. Harold Macmillan, pointed out that the duty of the Royal Navy in securing our sea communications was unchanged and that the perfection of modern weapons and techniques is increasing the ability of the Navy to discharge that duty. "During the last year," he said, "all our operational carriers have been brought up-to-date. Jet aircraft have improved their efficiency and, with the new inventions of the angled deck and mirror landing sights, the risk of accident to these and even faster aircraft has notably decreased."

The programme of new construction, he said, was virtually completed and "the Navy is now free to look forward to the next generation of ships which will emerge from the inventions of today." The Minister made no comment on a suggestion, put forward earlier in the debate, that the Royal Navy and Royal Air Force should be amalgamated.

Turning from the Navy to the Army and Royal Air Force, Mr. Macmillan spoke first of the employment of helicopters to help in solving some of the transport problems of the land forces, reminding the House that a joint experimental unit was about to be formed to collect information by practical trials.

He next referred to the Government's decisions concerning anti-aircraft gun defences in the United Kingdom. "The development of nuclear weapons and of long-range aircraft of high speed and capable of operating at great altitude had," he said, "radically reduced the effectiveness of anti-aircraft gun defences." It would be necessary, he thought, to retain a number of heavy and light A.A. regiments to defend field forces and certain vital targets, but this would not justify the retention of Anti-Aircraft Command.

He pointed out, also, that since only a small proportion of the units in A.A. Command were manned by Regulars, this decision would mean the disbandment of a very large number of Territorial units. (No mention was made of whether or not this manpower might be made available to the R.A.F., under whose command the new anti-aircraft weapons are to operate.)

Lastly, Mr. Macmillan came to the matter of the Royal Auxiliary Air Force. "The Government," he said, "had given a great deal of consideration to the problems of organization, equipment and training of the squadrons of the Royal Auxiliary Air Force, problems which had become intensified by the introduction of the swept-wing fighter and the growing complexity of the air-defence system."

After paying a tribute to the high traditions and "glorious record" of the R.Aux.A.F., the Minister continued:—

"It would not be possible for the auxiliary squadrons, if they were re-equipped with the swept-wing aircraft, to train to a standard high enough to enable them to take their place in the front line, as squadrons, immediately on the outbreak of war, and that is what all fighter squadrons must be required to do in present conditions, because they are needed at the very first moment. So an effective fighter squadron of modern aircraft must really be a whole-time duty.

"The Government have, therefore, decided to alter the organization of the Royal Auxiliary Air Force in such a way as to enable those auxiliary pilots who can give the time to it to train on swept-wing aircraft. We have decided not to re-equip the squadrons with these machines, but to train the men. By this means the auxiliary squadrons will provide reserves behind the Regular squadrons in war. Each squadron will be linked with a Regular squadron and auxiliary pilots will fly the aircraft of the Regular squadrons. This will be instead of equipping the auxiliary squadrons with machines of their own, with all the difficulties of maintenance. The pilots will fly the new modern machines, but those which are held and maintained in the Regular squadrons.

"The auxiliary squadrons will retain their town headquarters and their present airfields, and each squadron will retain a training flight composed of Meteors or Vampires. The auxiliary pilots will fly as necessary to Regular airfields to carry out their training on swept-wing aircraft. Auxiliary ground personnel will continue to be employed at their home airfields, and plans are being considered to train them so that they will be able, in the event of war, to service the latest types of fighter aircraft. These changes will be introduced progressively as the Regular squadrons are re-equipped with modern swept-wing fighters. Affiliation will not begin until Regular squadrons have worked up to full efficiency on their new aircraft."

Asked whether this decision meant the disappearance of the 20 R.Aux.A.F. squadrons, the Minister said he thought not. He looked upon them as a first reserve to the Regular units flying the swept-wing fighters.

Home Command Posting

AMONG recent appointments is that of A. Cdre. M. H. Dwyer as A.O.C., No. 62 (Southern) Group, Home Command. Contrary to our report of December 3rd on the annual dinner of the O.U.A.S., he has succeeded A. Cdre. B. C. Yarde, C.V.O., C.B.E., in this post. A. Cdre. Yarde has been appointed Commandant-General of the R.A.F. Regiment and Inspector of Ground Combat Training, with the acting rank of air vice-marshal. The A.O.C-in-C. of Home Command is Air Marshal Sir Harold Lydford.

New M.E.A.F. Headquarters

A BRIEF ceremony marked the installation last Friday of Air Marshal Sir Claude B. R. Pelly, C-in-C. Middle East Air Force, in his new headquarters at Nicosia, Cyprus. On arrival he was greeted by A.V-M. G. I. L. Saye, A.O.A., A.V-M. J. N. T. Stephenson, S.A.S.O., A. Cdre. C. D. C. Boyce, A.O.C. Cyprus, and G/C. J. H. Irvin, Station Commander at Nicosia.

This ceremonial installation came at the end of a sea and air lift in which Valettas, Pembrokes and L.S.T.'s were used.

"Flight" photograph

The control tower at Marham made an excellent grandstand during the visit of the German Parliamentarians to that station on November 30th (see page 833). The Canberra in the background is one of the No. 57 Squadron aircraft which gave a demonstration for the benefit of the German spectators.

Squash Champions

FOR the third time, Sgt. A. E. Catherine won the R.A.F. Squash Rackets Championship at the Lansdowne Club last Saturday. In the final he beat F/L. A. A. Ramus 9-7, 9-10, 9-4, 9-3.

Wg/O. M. F. Arkell is the new W.R.A.F. champion. She beat Sq/O. E. L. Caro by 9-0, 10-8, 9-0.

Jet Training in High Latitudes

AN English Electric Canberra and a Handley Page Hastings of the R.A.F. Flying College, Manby, Lincs, will be flown to Norway next Monday, December 13th, for the first jet-training flights by students of the College in high latitudes. Twenty staff, students and ground crew will take part in the exercise, which follows the survey flight in October, when the Canberra *Aries IV* made the first flight by a British jet aircraft over the geographical North Pole. W/C. M. D. Lyne, A.F.C., will command the detachment.

The object of the flights is to give advanced training in Arctic navigation for staff and student navigators, and to gain experience in operating jet aircraft in Arctic regions, where reliance must be placed largely on navigation by sun, moon or stars. As in the survey flight, the Canberra will use the Royal Norwegian Air Force base at Bodö, north of Narvik. Manned by students, it will fly due north from Norway to latitude 85-87 deg N. (nearly to the Pole), making two flights on December 14th and two on December 15th to latitude 85 N., and a fifth flight on December 16th to latitude 87 N. Each flight will last about six hours. The distance from Bodö to the North Pole is 1,550

SERVICE AVIATION . . .

statute miles, and the round trip as far as 87 deg N. will therefore be about 2,700 miles. The route flown will be over Spitzbergen, the northern tip of which lies on the limits of unnavigable pack-ice, and this will be the only land crossed during the sorties.

Both aircraft are due to return on December 17th—the Canberra to Manby's satellite airfield at Strubby, and the Hastings to Manby itself.

New Zealand Appointment

THE appointment has been announced of G/C. I. G. Morrison, O.B.E., as Air Member for Supply in the Royal New Zealand Air Force and third member of the N.Z. Air Board. He succeeds A. Cdre. G. Carter, O.B.E., who is retiring.

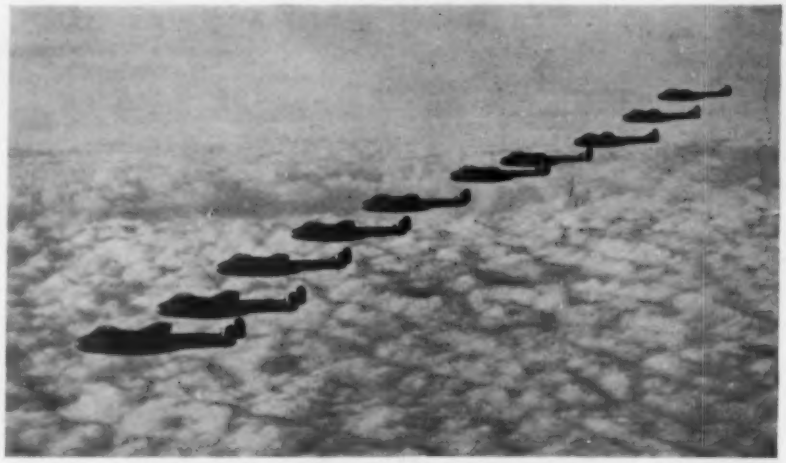
G/C. Morrison served with the R.A.F. before the war and, with the R.N.Z.A.F., flew on operations in Britain and the Pacific. Before his new appointment he commanded R.N.Z.A.F. Station Wigram.

"Seventy Seven" Goes Home

NO. 77 SQUADRON, Royal Australian Air Force, is returning home after eleven years' continuous overseas service. The unit was expected in Sydney on December 3rd aboard the aircraft carrier H.M.A.S. *Vengeance*. Formed in Western Australia in 1942, "77" was in action in every war theatre in the south-west Pacific before being posted to Japan for service with the occupation force in 1945. From Japan the squadron moved to Korea on the outbreak of war there, and was the first Allied squadron to go into action. In recognition of its outstanding service, the squadron has been awarded a Queen's Standard. Other R.A.A.F. squadrons which have been similarly honoured are Nos. 1 and 3.

Technical Training's Rugby Win

THE final of the rugby football competition between the R.A.F. Commands was won by Technical Training Command at Biggin Hill last week. They beat Fighter Command by four tries (12 points) to nil in very heavy conditions. The winning team were: F/O. Franklin (Jurby), A.C. Williams (Hednesford), A.C. Howard (Compton-Bassett), A.C. Roberts (Hednesford), A.C. Davies (Locking), A.C. Tregidon (Hednesford), A.C. Templeman (West Kirby), F/O. Bleasdale (Halton) (captain), L.A.C. Norris (Watchet), F/O. Collard (Locking), Off. Cdt. Hankin (Jurby), S.A.C. Sewell (Catterick), A.C. Campbell (Yatesbury), A.C. Wicks (Locking), F/O. Robins (Henlow).



Creditable not only for the standard of flying but for the 100 per cent serviceability it bespeaks is this view of the Vampires of No. 613 (City of Manchester) Squadron. We learn from the Squadron's C.O.—S/L. J. B. Wales—that the aircraft have amassed a total of 6,300 hr.

R.A.F. Appointments

THE following are among recent appointments announced by the Air Ministry. In command, G/C. K. V. Garside, D.F.C., to Topcliffe; G/C. D. F. Macdonald to Duxford (instead of to H.Q. Bomber Command as previously announced); G/C. D. Peveler, D.S.O., D.F.C., to Gutersloh; W/C. T. M. Buchanan to Newton; Act. W/C. J. W. McKelvey, M.B.E., to No. 60 M.U., and Act. W/C. V. R. Marshall to No. 1 Wing, Aden Protectorate Levies.

Air Ministry appointments include those of G/C. J. K. Rotherham, O.B.E., to the Department of Air Member for Supply and Organization; W/C. H. R. Allen, D.F.C., W/C. J. F. Davies, D.F.C., A.F.C., and W/C. D. T. M. Lumsden, M.B.E., to the Department of the Chief of Staff; and W/C. J. F. Sanders to the Department of the Air Member for Personnel.

G/C. A. R. D. Macdonell, D.F.C., has been appointed to the Joint Services Staff College for Directing Staff duties; G/C. F. H. Tyson to the School of Land/Air Warfare, to instruct; W/C. R. J. Burrough, D.F.C., to No. 7 School of Recruit Training, to instruct; and Act. W/C. J. M. Gilchrist, M.B.E., to R.A.F. Staff College for directing staff duties.

For flying duties W/C. C. F. Bradley, D.S.O., has gone to Laarbruch (Germany); W/C. D. D. Haig, D.S.O., D.F.C., to Wittering; and Act. W/C. D. E. Kingaby, D.S.O., A.F.C., D.F.M., to Celle.

Administrative staff duties appointments include those of G/C. R. C. Jones, C.B.E., to Home Command; G/C. A. W. Rule to No. 41 Group; W/C. R. W. S. Cross, O.B.E., to No. 23 Group; and W/C. T. W. Hodgson to Transport Command.

For air staff duties Act. G/C. L. E. Giles, O.B.E., D.F.C., A.F.C., and W/C. I. O. B. Carlson have been appointed to Bomber Command; W/C. P. M. Brothers, D.S.O., D.F.C., and W/C. W. G. Clouston, D.F.C., to Fighter Command; W/C. E. J. Harrington, O.B.E., to Technical Training Command; W/C. J. A. Slater, D.F.C., to No. 22 Group; W/C. N. McClelland, O.B.E., to No. 19 Group; W/C. L. Mathias to M.E.A.F.; and Act. W/C. R. M. Blackmore to No. 64 (Northern) Group.

G/C. J. D. F. Bruce has gone to No. 3 Group for technical staff duties; W/C. J. A. Chorlton, O.B.E., to Coastal Command and Act. W/C. A. C. Whitfield to No. 11 Group.

Administrative appointments include those of W/C. J. Lee, O.B.E., to Ruislip; W/C. G. B. M. Bell, O.B.E., to Yatesbury; Act. W/C. F. E. Lilley to Hednesford; and Act. W/C. A. J. Sansom to St. Athan.

For technical duties, W/C. G. J. Pearn has moved to Upwood and W/C. W. G. Womersley to Willesbourne Mountford. W/C. B. Deaves, D.F.C., has gone to Gaydon for staff duties.

Two appointments abroad are those of W/C. M. H. de L. Everest, A.F.C., to Lisbon as Air Attaché and W/C. E. A. Harrop, O.B.E., to A.A.F.C.E. for staff duties.

A.V-M. H. W. Heslop, C.B., O.B.E., Senior Technical Staff Officer of Middle East Air Forces, at Abu Sueir, Egypt, with his technical staff officers. A.V-M. Heslop is shortly retiring after 37 years' service.

(Seated, left to right) S/L. R. H. Stephenson, O.B.E., S/L. F. S. Cocker, D.F.C., S/L. R. E. Smith, W/C. R. W. Searles, W/C. Grundy, G/C. H. J. Irens, A.V-M. H. W. Heslop, G/C. J. McQ. Fitch, W/C. R. W. Williams, W/C. E. Easton, W/C. W. A. Jones, W/C. E. C. C. White, S/L. A. W. S. Brown. (Standing, left to right) S/L. G. T. Smyth, S/L. P. C. Ganthony, F/L. J. E. Sanderson, F/L. A. E. Hough, F/L. R. L. Armstrong, S/L. A. C. Needham, S/L. H. C. Taylor, F/L. W. G. Didcote, S/L. J. C. Dixon, F/L. E. Scott, M.B.E., S/L. J. Elliott, S/L. H. H. Dent, S/L. N. Paxton, F/L. A. N. Bryron, S/L. I. J. de la Plain.

THIS WAY UP

Component-packaging Problems Discussed in Two S.A.E. Lectures

INDICATIVE of the amount of study now going into problems concerned with packaging of aircraft and armament components and accessories is the fact that two full-length papers were devoted to the subject at the recent Los Angeles meeting of the Society of Automotive Engineers.

In the first of these lectures Stanley M. Birnbaum, of Wright Air Development Centre, Wright Patterson A.F.B., described research and development work undertaken on behalf of U.S.A.F. Air Materiel Command and other organizations. Mr. Birnbaum explained that the duties of the packaging section of the laboratory were principally to investigate development and standardization of packaging materials, containers and procedures. Although, he said, their general specifications had proved adequate, a new consideration had arisen from the constantly increasing use of air transport for various types of equipment. Air Force contractors were already "protection-conscious" and it now remained to make them "weight-and-cube-conscious." Considerable thought had been given to this problem. A lightweight crate had been developed, consisting of an interior framework with an exterior sheathing which could be removed for the air shipment portion of a journey. Also, paper-overlaid veneer boxes made of veneer panelling faced with Kraft paper had been developed; although lighter than conventional cleated plywood or nailed wood boxes, they had an equivalent performance.

For the air shipment of aircraft engines, cradles were now taking the place of extremely heavy metal containers commonly used for engine shipment in the United States. For carriage of corrosive, toxic and inflammable liquids, polyethylene containers were replacing the heavy glass carboys previously employed.

The lecturer went on to say that the packaging engineer could make further major reduction in weights and volumes if more information were available to him from the consignees regarding the "fragility" of the contents—and therefore the amount of cushioning required—and the service conditions to be encountered on the journey. He had found that instrument and equipment manufacturers had a tendency to be unduly cautious when requested to state the maximum accelerations to which their equipment could be subjected. His laboratory experience had shown that in the case of such items as aircraft engines, bombsights and computors, all of which had been rated by their manufacturers as being capable of withstanding certain maximum accelerations, rough-handling tests to which they were subjected proved that they were capable of withstanding heavier accelerations and still being serviceable when placed under functional test afterwards.

Corrosion Inhibitors

Reviewing various types of sealed package, Mr. Birnbaum discussed the use of volatile corrosion-inhibitors. The question had arisen as to how it was possible to tell that re-preservation was required. An indicating method had been developed that functioned for three of the five approved materials used in such processes. It consisted in the withdrawing of a sample of atmosphere from the interior of the package, this sample then being circulated about a steel test-specimen upon which condensation was deposited by means of dry ice or ice-water; if the test panel corroded, re-preservation was required. Research was continuing to develop an indicating method which would be instantaneous, which would not require that the package be opened and which would work with all volatile corrosion-inhibiting materials.

Speaking of glass-fibre containers, the lecturer said that the Air Force had, in general, been unsuccessful with them, and that there had been failures in attempts to develop large containers for such items as engines and guided missiles; these failures were surprising, because fabricators of glass-fibre had been successfully making many major aircraft structural parts. Some of the failures had been due to the poor design, such as bolting directly through the shell and supporting loads on extremely thin sections. But interest in this material had not waned; it had many advantages over metal, e.g., light weight, high strength/weight ratio, good shock-absorption qualities and freedom from corrosion; nor was it a "strategic" material.

Enlarging on the packaging of guided missiles, the lecturer pointed out that malfunctioning of the most minor component through transit damage would cause failure of the whole missile, so packaging and storage must be perfect; cost, weight and volume were of secondary importance. Such a missile might be as big as a light bomber; so why bother about packaging it at all? Why not use a strippable coating or a flexible moisture-proof, vapour-proof bag? And for storage, why not employ a dehumidified building and eliminate the requirement for air-tight containers?

Mr. Birnbaum concluded with a brief review of some detail problems and solutions arrived at in the laboratory. (1) With the wider use of synthetic greases in bearings, conventional barrier materials had de-laminated and proved inadequate; it had been determined that bearings could best be preserved by immersion in light preservative oil in sealed metal cans. (2) Stainless steel drums used for the storage of corrosive liquids had corroded in a short time; finally a solution was found in the use of drums made of high-purity aluminium. (3) Packing of parachutes in cylindrical metal cans with bolted locking rings had proved unsatisfactory, especially since parachutes are normally folded rectangularly and also have to be periodically inspected; now a rectangular, light-gauge, double-seamed, air-tight can, incorporating a replaceable lid, had been developed for the purpose. (4) Pressure-sensitive tape had been satisfactory between temperatures of 32 deg F and 150 deg F, but it seemed desirable to develop a tape which would have efficient adhesion at extremely low temperatures; a tape had now been produced which was satisfactory down to −80 deg F.

Establishing "Fragility"

The second paper on packaging problems read at the S.A.E. meeting dealt with the "fragility rating" as a potential aid to package cushion design. The author was W. H. Skidmore, of Western Electrical Instrument Corporation.

Dismissing the obvious factor of "crushability" as being easily understood and provided against, the lecturer went on to make a detailed analysis of the incidence of excessive acceleration, deceleration and shock. The data were not simple to analyse; they were not always in elementary descriptive terms; and, in many instances, the figures were of questionable value. But it appeared that, barring an accident to the vehicle, the data could be interpreted to indicate that no in-transit shock would exceed the effect of a 30in drop on to a firm floor and that fundamental vibration frequencies of any consequence would not exceed 60 c.p.s. in transit.

No factual numerical data appeared to be on hand for roughness of handling at loading, transfer, and unloading points. There was, however, excellent reason to believe that height of drop would be some function of the size, weight, and shape of the package. This concept had been accepted to a considerable extent in Great Britain and roughly, the following seemed both reasonable and confirmed by observation:—

(1) If volume and weight were such that the package could be thrown, it was likely to be so treated at every handling station unfamiliar with the nature of the contents.

(2) If the package were too small and light to be thrown, it would be handled in bags or baskets, and the greatest likelihood of accident would be that of being crushed.

(3) A small package too heavy to throw would probably be hand-carried, and carefully.

(4) A larger and heavier package than (1) might be slid or carried and dropped, perhaps 30 to 40in.

(5) A two-man package would receive careful treatment.

(6) Still larger and heavier packages, requiring mechanical means to lift and move them, seldom dropped more than 6in to 10in.

Having examined these possibilities in some detail, the lecturer went on to elaborate on the possibilities of fixing, for any given item of equipment, a "fragility rating" calculated from data supplied by the manufacturers. The present concept of such a rating was that it should consist of two parts, the first being the maximum acceleration which the item could tolerate, divided by the acceleration of gravity—or, more colloquially, the number of "g's" which the item could tolerate without damage. The second part would be a statement of any natural frequencies of any of the components of the item which occurred below 75 c.p.s. The first part might be considered the "rough-handling" part and the second the "in-transit" part.

By the use of a fragility rating, together with certain standardized methods of test and calculations, and statements of specifications, it seemed possible to design cushioning which would prove any desirable degree of physical protection.

THE INDUSTRY

Smiths "Guided Weapon" Appointment

THAT Smiths Aircraft Instruments, Ltd., are undertaking guided-weapon work on a considerable scale is suggested by the news that they have appointed a "technical executive in charge of guided-weapon activities." Selected for the post is Mr. C. G. Roberts, M.Sc., who, after gaining distinctions at two universities (Wales and London), was engaged in lecturing and then joined M.A.P., where he worked at the Telecommunications Research Establishment on radar development. After the establishment had moved to Great Malvern he was engaged on airborne applications of centimetric radar and was eventually in charge of the group responsible for A.I. radar in Service aircraft. Shortly after the war he worked on cloud-and-collision-warning radar and was for a time collecting technical data in the Singapore area. In 1947 he went over to guided-weapon work, joining the staff of the R.A.E. at Farnborough. As senior principal scientific officer he was in charge of the weapons division of the guided weapons department.

Joining H. M. Hobson

APPOINTED manager of the service department of H. M. Hobson, Ltd., is W/C. J. G. Freeman, R.A.F.(Ret.). Joining the Service in 1921, W/C. Freeman learned to fly at Sealand and, after serving with Nos. 23, 6 and 14 Squadrons, became a flying instructor to the Oxford University Air Squadron. Returning to the United Kingdom in 1939 after a tour of duty with the Royal Iraqi Air Force, he was appointed to the Technical Staff of H.Q. Flying Training Command. From 1947 to 1949, he was Senior Technical Staff Officer, Ceylon, and subsequently held the posts of S.T.O. at Hullavington, Worksop and Driffield.

W/C. J. G. Freeman.

The new Marconi college at Chelmsford is now virtually complete. In this view in one of the laboratories, overseas students are seen undergoing training in operation and maintenance of the AD-200 V.H.F. D/F. equipment.

Ultra-light Foamed Plastic

A RANGE of light-weight foamed plastics marketed under the name of "Plasticell" is described in a brochure from the Airscrew Co. and Jicwood, Ltd., Weybridge, Surrey. Available in panels and sheets, and in soft and hard grades, Plasticell is stated to be one of the lightest materials known. The soft variety is available in five different densities, ranging from 0.05 sp.g (3.1 lb/cu ft) to 0.2 sp.g (12.5 lb/cu ft) and the hard grade in four densities, from 0.04 sp.g (2.5 lb/cu ft) to 0.2 sp.g (12.5 lb/cu ft). Absorption of water is stated to be nil and the material to be free from oxydization, rotting or any alteration with age. It is fire-resistant, and a good electrical insulator. Though, owing to its thermoplastic resin base, Plasticell softens under heat and should not normally be employed in temperatures above 70 deg C, it will retain all its mechanical properties in temperatures as low as −70 deg C; the soft grade hardens slightly in cold conditions but returns to normal with a temperature-rise.

The characteristics enumerated above make the material particularly suitable for use in various forms of flotation gear, in heat insulation, and in sound absorption; being obtainable in colours, the soft grade is also of value in interior decoration.

IN BRIEF

Known as "Kleenarc," a new anti-spatter paint for use in arc welding has been produced by the Arc Manufacturing Co., of Nitshill, Glasgow. Applied to the surface to be welded, it forms a protective skin which stops spatter and prevents slag particles sticking to the work; by assisting ionization it helps to stabilize the arc; and it also acts as a flux.

* * *

From Rocke International, Ltd., 59 Union Street, London, S.E.1, comes an instrument catalogue published by the Danish firm of Bruel and Kjaer, for whom they are London representatives. The catalogue, devoted to instruments for electrical, acoustical, radio-active, vibrational strain gauge and electrochemical measurements, is unusually comprehensive, covering as it does nearly 100 different items.

* * *

Number 14, vol. 1, of *Murex Review* consists of an admirably lucid and well illustrated treatise on the evolution and harnessing of atomic energy. The author, Mr. E. C. Piggott (chief chemist and metallurgist, Central Marine Engine Works, West Hartlepool), has covered his subject in a manner which strikes a nice balance between the technical and the popular. The review is published by Murex, Ltd., Rainham, Essex.

* * *

From the Magnetic Broadcasting Co., Ltd. (Suffolk Hall, 1 Upper Richmond Road, London, S.W.15), come details of their "Stethophone" system, by which radio or other transmissions may be received in earphones without any wire connection, so that the wearer may walk about quite unimpeded. The earphones operate on the induction principle, from a loop of wire laid round the boundaries of the area in which the device is used. Each pair of headphones, incorporating a volume control, weighs under 2 oz.

* * *

The scope of the activities of Tiltman Langley Laboratories, Ltd., of Redhill Aerodrome, Surrey, has been steadily widening in the past few years, so that, in addition to aeronautical research and development, the company now undertakes tasks including mechanical engineering, sheet-metal work and production of various special-purpose devices (in this connection, the company has recently acquired an interest in Mid-Century Engineering, Ltd.). In view of these developments, it has been considered that the company's original title is no longer appropriate, and the word "Laboratories" has accordingly been dropped, so that the name is now Tiltman Langley, Ltd.

* * *

Mr. A. E. Potter, for the past four years sales manager of Expandite, Ltd., has been appointed sales director. The company are specialists in joint-sealing techniques for civil engineering and building structures.

* * *

New decorative patterns are announced by Warerite, Ltd., (Watton Road, Ware, Herts) as additions to their standard range of laminated plastics. This material is used to a considerable extent in airliner interior furnishing.

* * *

The aircraft division of Vickers-Armstrongs, Weybridge, Surrey, have produced a new loose-leaf catalogue, superseding all previous editions, of their aircraft accessories. It gives detailed drawings and data on three types of fuel cocks, R, P and D; non-return valves; split-flap-type non-return air valves; and miscellaneous drain cocks, valves, pulleys, air pumps, etc.

* * *

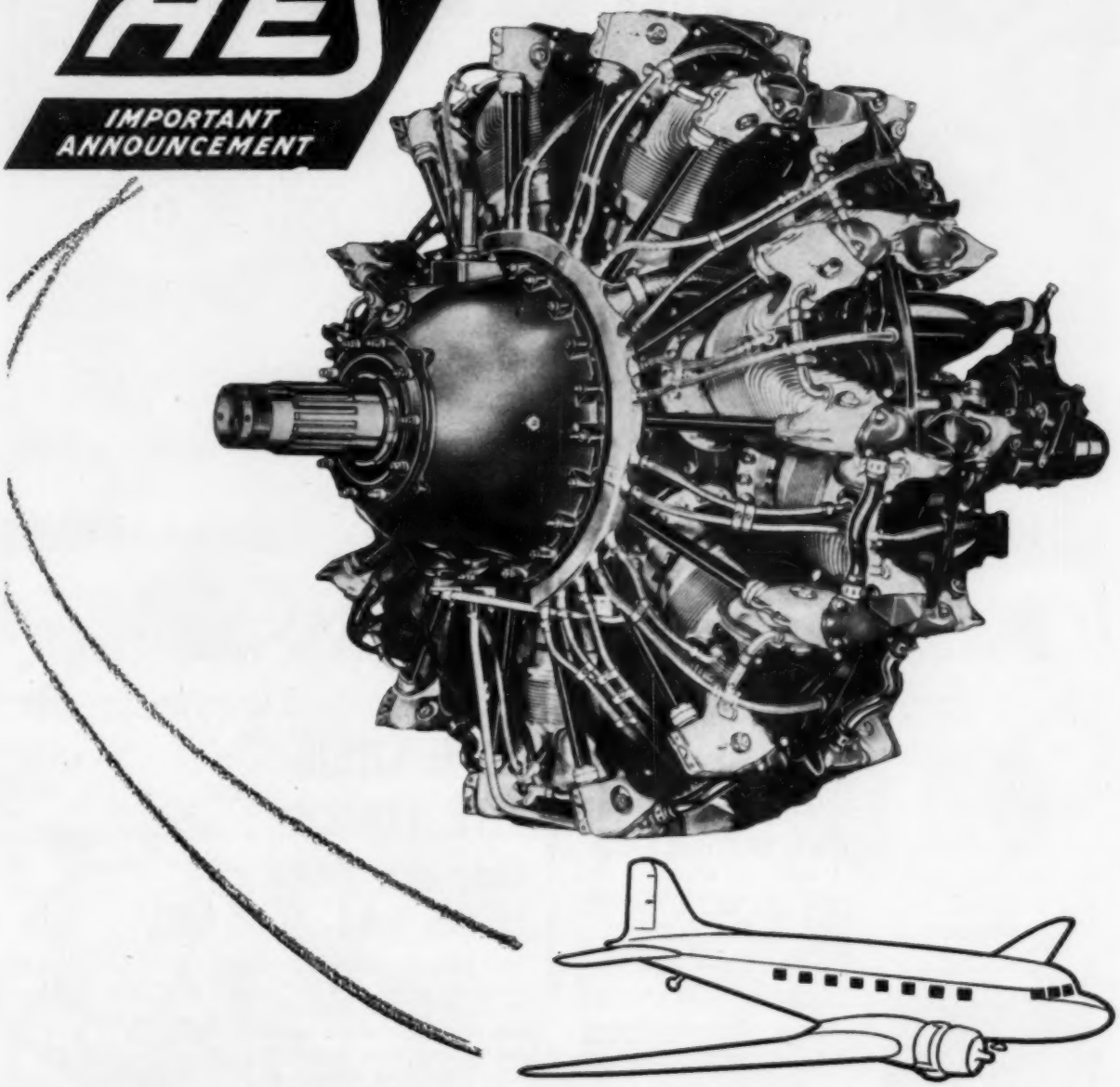
Associated Electrical Industries, Ltd., announce the reorganization of the A.E.I. companies into four groups: B.T.H., Ediswan-Hotpoint, M-V.E., and Overseas. The chairman of A.E.I. becomes chairman of each of the groups, and the respective managing directors for the groups mentioned above are Mr. E. H. Ball, Mr. A. N. E. McHaffie, Dr. C. Dannatt, Dr. I. R. Cox.

* * *

Lymington Borough Council have decided to confer the Freedom of the Borough on Mr. John Howlett, chairman and managing director of Wellworthy, Ltd., in recognition of "his many services to the Borough and his outstanding contribution to its welfare and development over a period of many years." The honour has been conferred only twice in the Borough's 800-year history.

AES

IMPORTANT ANNOUNCEMENT



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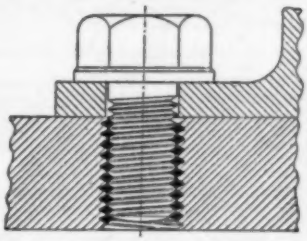

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PATENTS

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PUBLIC ANNOUNCEMENTS

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THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 428. From Airviews, Ltd., of Ringway Airport, Manchester, for a Seasonal U.K. Internal Service with D.H.89 aircraft for the carriage of passengers and supplementary freight between Manchester (Ringway) and Exeter with an intermediate traffic stop at Bristol at a frequency of from one to three services weekly, during the season from April to October inclusive each year, for a period of seven years, commencing 1st April, 1955.

APPLICATION No. 42/2. From Airlines (Jersey), Ltd., 4 The Parade, St. Helier, Jersey, C.I., for permission to extend to Plymouth their Normal Scheduled Service on the route Exeter-Guernsey-Jersey-Caen-Paris, approved by the Minister of Transport and Civil Aviation for operation during the period up to 31st March, 1963. The Company ask in addition to be allowed to operate direct flights between Plymouth and Guernsey and/or Jersey and between Plymouth and Paris.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons, and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, Westminster, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [2994

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FURTHER particulars from Civil Service Commission, Scientific Branch, 30 Old Burlington Street, London, W.1, quoting No. S/53/54 for Senior Scientific Officers and S. 52/54, S. 128/54 for the other posts. Completed application forms must be returned by December 31st, 1954. [2968

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VIBRATION engineers. A graduate engineer (Ref. F/24), with some mathematical ability, to predict vibration characteristics and to design trials establishing vibration and shock environment and to design appropriate isolation mountings. Vacancies also exist for junior test engineers (Ref. F/25) on this work.

STRESSMEN (Ref. F/18), with several years' experience of aircraft or missile stressing. Emphasis is placed upon structural and functional testing in support of design calculations.

GOOD salaries with bonus. Pension scheme incorporating life assurance. 38-hour five-day week. Apply, quoting appropriate reference, with full details of experience and qualifications, to the

ASSISTANT Manager, The Fairey Aviation Co., Ltd., Weapon Division, Heston Aerodrome, Hounslow, Middx. [2982

SCHEDULE Clerks required for the preparation and maintenance of spares schedules in connection with gas turbine and internal combustion Aero engines. Applicants must have had previous experience.—Please write giving age and details of previous experience to The Personnel Office, The de Havilland Engine Company, Limited, Stag Lane, Edgware, Middx. [2981

EXPERIENCED process planner required urgently for work in connection with light and medium machined parts, sheet metal details, and aircraft component assembly. Knowledge of details and subassembling estimating and/or rate fixing an advantage. Please apply in writing giving full details of experience to Personnel Office, Field Aircraft Services, Ltd., Nottingham Aerodrome, Tollerton, Nottingham. [2987

CENTRAL AFRICAN AIRWAYS CORPORATION

invite applications for the position of

MANAGER

FLIGHT TECHNICAL DEPARTMENT

OPERATIONS DIVISION

Qualifications required:

1. A minimum of four years' airline experience.
2. A sound knowledge of piston engine and turbo prop operating techniques.
3. Experience of lecturing and ability to lecture on the Rolls-Royce Dart, Viscount aircraft and Flight planning as applicable to this type.
4. A knowledge of modern navigation aids, air traffic control procedures and meteorology.
5. An Engineering Degree will be a recommendation.

Duties will consist of:

1. Preparation of technical manuals required for the operation of the Corporation's Viscount aircraft.
2. Technical training of aircrew in engine handling and Flight planning.
3. Flight testing of Corporation aircraft on performance checks.
4. Keeping fully informed of general developments in the technical field of Air Transport.

The following conditions will be applicable to this post, further details will be available to applicants at time of interview:—

1. Commencing annual basic salary of £1,550.
2. Cost of living allowance of 20 per cent is at present payable on the first £895 of the above basic salary.
3. Compulsory membership of the Corporation's Pension Scheme and Medical Aid Society, both of which are contributory.
4. Annual vacation leave at present 36 days in addition to 6 days occasional leave.
5. Certain travel privileges will be granted on the Corporation's regional and domestic services.
6. The Corporation will provide Personal Accident Insurance cover, equivalent to 2½ times the annual basic salary, as well as ordinary life cover of 1½ times the annual basic salary.
7. Assisted passages to Salisbury, Southern Rhodesia, will be available to the successful applicant and his family if any.

Applications should be addressed to the **Operations Manager, P.O. Box 1979, Salisbury, Southern Rhodesia.**

Closing date—31st December, 1954.

SITUATIONS VACANT

VICKERS-ARMSTRONGS, LIMITED

now in Production of Super-priority Aircraft

require:

Draughtsmen (Senior and Junior)

preferably with aircraft experience. Men with mechanical, structural and electrical drawing experience also considered.

Jig and Tool Draughtsmen

for designing machine fixtures, assembly tools and jigs.

Aircraft Planners
Ratefixers
Estimators

and

Inspectors.

Write giving full particulars including age and salary required for Personnel Dept., South Marston Works, Swindon, Wilts. [2952

SENIOR INSTALLATION DESIGN DRAUGHTSMEN

are required at

SUPERMARINE DIVISION

of

VICKERS-ARMSTRONGS, LTD.

for

ELECTRICAL, electronic and/or radio, radar aircraft work. Excellent positions for the right men able and willing to take responsibility, show initiative and follow the job through.

THE first requirement is for men with similar aircraft experience, but applications will be welcomed from others who have experience in the electrical or radio industry associated with aircraft and the like.

FULL details stating age, salary, etc., to

Personnel Dept.,
VICKERS-ARMSTRONGS, LTD.,
Supermarine Works,
Hursley Park,
Nr. Winchester. [2995

ELLIOTT BROTHERS (LONDON) LIMITED

CONTRACTS MANAGER

is required for the

AVIATION DIVISION

of the above Company

KNOWLEDGE of Air Ministry contracts procedure and costing and estimating systems together with experience of all aspects of factory routine is essential. Preference will be given to men with engineering qualifications and background and the ability to complete negotiations at an executive level.

APPLICATIONS giving full particulars of age, experience, qualifications and stating salary required to:—

PERSONNEL Officer, Century Works, Lewisham, S.E.13. [2935

ENGLISH ELECTRIC

Guided Weapons Division

invite applications for the post of

CHIEF INSPECTOR

at their new factory in
STEVENAGE, HERTS.

THIS post demands high technical qualifications together with administrative ability of a high order. Experience of all aspects of the aircraft industry would be a great asset. The appointment commands a salary commensurate with the experience and qualifications of the successful applicant who will be provided with housing if required. Applications giving full details of age and previous experience should be sent to Dept. C.P.S., 336/7, Strand, W.C.2, quoting Ref. 1354E and marking envelope 'Confidential'. [2988

VIKING ENGINEERS

REQUIRED for maintenance of Viking fleet. Only those experienced on Viking or Valetta aircraft will be considered.

FULL details to:

B. K. S. ENGINEERING, LTD.
Southend Airport,
Southend-on-Sea, Essex. [2973

HAWKER AIRCRAFT
LIMITED
CANBURY PARK ROAD, KINGSTON-on-THAMES

Applications invited for following positions

JIG & TOOL DRAUGHTSMEN

Applicants must be fully experienced on modern techniques

AIRCRAFT PROCESS ENGINEERS

Applicants must have at least five years practical aircraft experience, and be conversant with all modern manufacturing methods

Superannuation and all facilities

Please write fully to Personnel Officer

THE BRISTOL AEROPLANE
COMPANY LIMITED

requires:—

JIG & TOOL DRAUGHTSMEN

for work on highly important new projects.

Pension scheme, salaries and prospects of promotion on merit are excellent.

Applications, quoting E.D.23, giving details of experience, age and qualifications should be addressed to the

Personnel Manager,
The Bristol Aeroplane Co., Ltd.,
Engine Division, Filton House, Bristol.

DRAUGHTSMAN
AIRCRAFT INSTALLATIONS

SENIOR required for design work on components of aircraft cabin conditioning systems, scheme detail drawing of rig testing gear covering both basic plant and aircraft test rigs.

SUPERANNUATION

Applicants should have experience in both general and aircraft engineering and write fully to the

Personnel Supervisor
HAWKER AIRCRAFT LIMITED
Canbury Park Rd., Kingston-on-Thames

BLACKBURN & GENERAL AIRCRAFT LTD.
BROUGH, E. YORKS

require

SKILLED AIRCRAFT INSPECTORS

for final inspection of aircraft before flight. There are also a number of vacancies for skilled Inspectors on sub-assembly and component work.

EXPERIENCE ON MODERN AIRCRAFT ESSENTIAL

These are Staff positions with contributory pension scheme and insurance benefits. New houses at low rentals can be made available, early in 1955, to married men living outside the district.

Applications (to be treated in strict confidence) should be sent to the Personnel Manager at the above address.

SITUATIONS VACANT

DRAUGHTSMEN

STRESSMEN

AERODYNAMICISTS

SAUNDERS-ROE LIMITED have vacancies for junior aerodynamicists and all grades of draughtsmen and stressmen.

ANYONE wishing to be considered is invited to write in detail, or send a postcard for an application form, to the Personnel Officer at the address below.

HOUSING facilities, pension and staff assurance schemes, sports and social club, canteens, congenial surroundings.

SAUNDERS-ROE LIMITED (Ref. F/16), East Cowes, Isle of Wight. [2904

FERRY AIRPORTS LIMITED

THE following vacancies occur at our maintenance base at Blackbushe:

(a) Skilled air frame fitters, experience on Bristol Freighters and Hermes aircraft essential.
(b) Skilled engine fitters with experience on Bristol Hercules engines.
(c) Skilled electricians, experience on Hermes aircraft preferred.
(d) Instrument makers, skilled overhaul and repair.
(e) Radio mechanics, skilled repair and maintenance.

GOOD rate and conditions on interesting work. Application should be made to Personnel Office, Ferry Airports Limited, Blackbushe Airport, Camberley, Surrey. [2984

FLIGHT TEST OBSERVERS

IF you have a knowledge of gas turbine engines and have a high standard of education, hold a degree, Higher National Certificate or similar qualification, vacancies exist for this interesting and important work with Armstrong Siddeley Motors. Applications should be made to the Technical Personnel Manager, Reference CG/FTO3, Armstrong Siddeley Motors, Coventry. [2911

AIRCRAFT Design.

IF you have technical experience in Project Design work, we should be very pleased to hear from you.

WE can offer interesting work in a specialist group and are prepared to assist with accommodation.

DETAILS of age, qualifications and experience should be sent to Box 3J M 2504, A.K. Advg., 212a, Shaftesbury Avenue, London, W.C.2. [2970

ROCKET Experimental Division.

(1) A young energetic man with a degree or Higher National Certificate is required to work on the design of test rigs and provision of all equipment needed for testing rocket engines.
(2) Vacancies exist for two men with degree or Higher National Certificate in Mechanical Engineering to work on the development of complete rocket engines.

APPLY to Reference CG/RD4, Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. (Please state which section of the advertisement you are interested it.) [2947

HYDRODYNAMIC Research and Development.

STAFF urgently required for Design and Model Experimental work (including towing tank testing) on ship and aircraft projects.

TECHNICAL experience in an associated field, e.g., fluid motion or naval architecture, or the possession of a Higher National Certificate would be an advantage.

ASSISTANCE with accommodation will be provided.

WRITE to Box 3J M 2509, A.K. Advg., 212a, Shaftesbury Avenue, London, W.C.2. [2969

DRAUGHTSMEN. Owing to an extensive development programme, Ruston & Hornsby, Ltd., require additional draughtsmen immediately.

DESIGNER draughtsman experienced with fuel injection equipment and capable of carrying out hydro-dynamic calculations.

DESIGNER draughtsman experienced in medium speed diesel engine design, suitable for industrial and marine application.

DRAUGHTSMEN experienced in high and medium speed diesel engine installation work, suitable for industrial and marine application.

DRAUGHTSMAN experienced in diesel loco design, but first-class experience is not essential with regard to the engine and gearbox unit.

DRAUGHTSMEN experienced in high speed diesel engine design and also their application to transportable and mobile installation.

JUNIOR draughtsman required for detail work in connection with high speed engines and their application to transportable and mobile units.

DRAUGHTSMAN experienced in design of gearbox units applicable to marine and loco installations.

AGE 24 and upwards. Salaries £550-£750 p.a. according to age and qualifications. Posts pensionable at 25 years of age and over. Applications giving age, qualifications and experience, and stating first preference; and senior applications giving first and second preference to Employment Manager, Ruston & Hornsby, Ltd., Lincoln. [2990

DERBY AVIATION, LTD., require two part-time flying instructors for regular duties at Elstree Aerodrome, Herts. [2964

SITUATIONS VACANT

FIELD AIRCRAFT SERVICES, London Airport, require the following personnel:—
LICENSED and unlicensed radio mechanics.

A. AND C. licensed ground engineers for Viking, York and Dakota aircraft.

A. AND C. Viking and York engineers for flying duties.

THERE are also several vacancies for:—

FULLY-EXPERIENCED aircraft fitters and riggers for the London Airport base.

APPLICATIONS, in writing please, to Personnel Officer, F.A.S., Ltd., Croydon Airport, Surrey. [2925

CHIEF inspector required, fully conversant with A.I.D. and A.R.B. procedure. Also
DRAUGHTSMAN for aircraft testing and ground equipment. Apply giving details of experience to Rollasons, Croydon Airport. Tel. CRO 5151. [2978

MINISTRY OF SUPPLY, R.A.E., Rocket Propulsion Department, Westcott, Bucks, requires
(1) Physicist or electrical engineer for recording work on rocket motors. Some knowledge of electronics required and familiarity with electrical instrumentation and measurement techniques desirable;
(2) Physicists or mechanical engineers. (a) For experimental and theoretical work on development of components for liquid and solid propellent rocket motors, (b) for work on heat transfer problems in rocket motor nozzles.
Good mathematical training and some relevant experience desirable. Quals. Higher School Certificate (Science) or equivalent, but possession of H.N.C. or pass degree, etc., may be an advantage. Salaries according to age, experience, etc., within ranges, Experimental Officer (min. age 26) £690–£850; Assistant Experimental Officer £276 (age 18)—£615. Women somewhat less. Application forms from M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A 346/54A. Closing date December 31, 1954. [2975

A SENIOR aerodynamicist required for a responsible position in the wind tunnel department of a leading aircraft firm.
QUALIFICATIONS. — Preferably an Honours Degree in engineering, physics or Maths. Experience in high speed wind tunnel work essential, together with organising ability. Please write to Box 0442. [2965

SENIOR and junior draughtsmen required for interesting work on remote control for aircraft and atomic equipment.—Apply in writing to Teleflex Products, Ltd., High Road, Chadwell Heath, Essex. [0720

FLIGHT test aerodynamicists are required for work on flight research and development at Woodford Aerodrome near Stockport. Previous experience is desirable and applications giving full particulars should be addressed to the Labour Manager, A. V. Roe & Co., Limited, Greengate, Middleton, Manchester. [2916

THE continued expansion of the Aircraft Equipment Division of The English Electric Company has caused a number of additional vacancies on the technical staff of the division, and applications are invited from both senior and junior engineers to fill the following grades of technical appointments:
(1) Systems Engineer, capable of analysing system characteristics of both AC and DC aircraft specifying components. To be experienced in methods of protection, voltage regulation, load sharing, system stability, etc.
(2) Control Gear Designer, experienced in design of contractors, circuit breakers, relays, etc., for both AC and DC systems. Ability to "miniaturise" designs a great asset.
(3) Magnetic Amplifier and Transductor Designer, to be capable of designing these units to basic system requirements.
THESE are senior positions and applicants for the above should preferably be of degree standard, and at least H.N.C.
(4) Engineer or Physicist, with aerodynamic or thermo-dynamic experience which can be applied to heat exchange problems on electrical equipment.
(5) Designer-Draughtsmen, experienced in mechanical engineering and control gear engineering.
(6) Contracts Engineers and Technical Representatives.
TECHNICAL Representatives should have had previous experience in the aircraft industry, but for all other appointments this is not necessary.
PLEASE apply in confidence to Ref. No. S.A.47A., Dept. C.P.S., 336/7 Strand, W.C.2, with full particulars of past experience and qualifications, etc., and indicating interested appointment. [2932

AN aerodynamicist is required by the aircraft division of the English Electric Company. Applicants should have a good honours degree in engineering or an equivalent qualification followed by several years' experience in the aircraft industry, preferably on stability and control work. Please apply quoting Ref. 435P. to Dept. C.P.S., 336/7, Strand, W.C.2. [2986

LARGE aircraft manufacturers require a general manager for one of their subsidiary factories in the North which has a total labour force exceeding 2,000. The appointment, which will carry a salary of not less than £2,500 p.a., offers an excellent opportunity to a man of outstanding ability, preferably with good knowledge and experience of aircraft production. Applicants should write, giving full details of their career and date of availability, to Box F.559, c/o 191, Gresham House, E.C.2. All replies will be treated as strictly confidential. [2917

THE HELICOPTER DIVISION
OF
SAUNDERS-ROE LTD.
at SOUTHAMPTON AIRPORT

are enlarging their Design Team and invite applications for the following vacancies:—

1. SENIOR TECHNICIAN
This post carries considerable responsibility and requires a knowledge of helicopter aerodynamics and vibration problems. A Degree is essential, preferably with Honours.

2. SENIOR STRESSMAN
Preferably with a Degree and at least four years experience in aircraft stressing. Helicopter experience would be an advantage.

3. TECHNICIANS
Technicians are required for work on helicopter aerodynamics, performance and vibration analysis and for project investigations. A Degree or H.N.C. is a requirement.

4. INTERMEDIATE STRESSMAN
With experience in aircraft stressing. A University Degree or H.N.C. is desirable.

5. PROJECT DRAUGHTSMAN
Experience in aircraft project design would be an advantage.

6. ELECTRICAL DRAUGHTSMAN
To take full responsibility for electrical installation work in the Division.

Salaries will be commensurate with age and experience. Please apply to:—

Personnel Officer, Saunders-Roe, Ltd., East Cowes, Isle of Wight.

THE LONDON DESIGN OFFICE
of
Short Brothers & Harland Ltd.
EAST INDIA HOUSE,
REGENT STREET

has vacancies for Draughtsmen of the following categories:—

Structural Draughtsmen for work on fuselage, wings, etc.

Mechanical and Electrical Draughtsmen for work on hydraulic or pneumatic systems and power plant installations.

Prospects and pay are good. The work is of great interest.

Applications to **Staff Appointments Officer, P.O. Box No. 241, Belfast,** quoting reference S.A.20, giving relevant particulars and salary expected.

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SITUATIONS VACANT

VACANCY occurs for assistant planning engineer. Must have experience of maintenance planning and scheduling of large fleet. Application should be made to Personnel Office, Ferry Airports, Ltd., Blackbushe Airport, Camberley, Surrey. [2977

AIRCRAFT Inspectors required for details, major assemblies, final erection and flight shed work. Good pay and prospects for suitable men. Apply stating age and particulars of experience to Personnel Officer, Hawker Aircraft (Blackpool), Ltd., South Shore, Blackpool. [2958

CHIEF stressman is required by Normalair, Ltd., to be responsible for strength calculations in connection with aircraft pressurizing and air conditioning equipment, including cold air units and high altitude breathing equipment, and other new projects. An engineering degree or equivalent is essential.
APPLICATIONS, stating age, experience, qualifications and salary required, are to be addressed in the first instance to the Personnel Officer, Normalair, Ltd., Yeovil. [0347

H. M. HOBSON, LTD., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, stressmen. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Fordhouses, Wolverhampton. [0420

SENIOR and Junior Stressmen vacancies for interesting programme of project and development work. Previous experience not essential for junior posts. H.N.C. minimum qualification. Salary in accordance with experience and qualifications. Full particulars in writing to Personnel Manager, Flight Refuelling, Ltd., Tarrant Rushton Airfield, nr. Blandford, Dorset. [2962

ROCKET Division. Vacancies, with good prospects, exist in a young and enthusiastic team for technical assistants. Applicants must possess at least a Higher National Certificate in Mechanical Engineering. Salary commensurate with qualifications, previous experience necessary.—Apply to the Technical Personnel Manager, Armstrong Siddeley Motors, Coventry, quoting Reference CG/RD3. [2923

HOUSING assistance will be offered to chargehand fitter with wide production experience of aircraft type hydraulic installation required by manufacturers of materials handling vehicles. Pleasant country district, 1 hour London. Good prospects for advancement. Canteen and social facilities. Please write giving details of past experience, age, present salary, salary required, married/single to Box No. 0510. [2976

TECHNICAL author required for work on handbooks and similar publications. Qualifications call for apprenticeship or equivalent training in aero engineering, and previous experience as a technical author. Please write in confidence stating age and giving full details of previous experience to The Personnel Officer, The de Havilland Engine Company Limited, Stag Lane, Edgware, Middlesex. [2972

TECHNICAL assistants. Vibration and structure testing. Vacancies exist for applicants with at least a Higher National Certificate in Mechanical Engineering. The work is interesting with good prospects. Previous experience unnecessary. Salary commensurate with qualifications.—Apply to Technical Personnel Manager, Armstrong Siddeley Motors, Coventry, quoting Reference CG/ME4. [2924

TECHNICAL Illustrator required, with considerable practical experience of illustrating for descriptive manuals, brochures, etc. Ability to produce first-class perspective and half-tone illustrations from workshop drawings. State experience, age and salary required. —Apply in writing to Personnel Manager, Flight Refuelling, Ltd., Tarrant Rushton Airfield, Nr. Blandford, Dorset. [2980

TECHNICAL assistants required for compilation of aero-engine build instructions. Applicants should be conversant with engine build schedules. Engineering apprenticeship essential. National Certificate an advantage. Apply, quoting E.D.21, and giving particulars of qualifications, experience and age to the Personnel Manager, The Bristol Aeroplane Company, Limited, Engine Division, Filton House, Bristol. [2946

LOCKHEED Hydraulic Brake Co., Ltd., Leamington Spa, invite applications from senior and junior technicians to undertake performance prediction and stress analysis in connection with projected landing gears, flying control systems and advanced hydraulic equipment. Good salary with attractive profit sharing and pension schemes. Applications giving full details of qualifications, experience and salary required to Personnel Officer. [2989

JUNIOR engineer for interesting design and development work on electronic and vibration test equipment. Applicants should have O.N.C., or equivalent, a sound knowledge of industrial electronics, be capable of wiring prototype equipment to approved standards, and working on own initiative if required to do so. Good welfare facilities including staff pension scheme. Applications in writing to the Personnel Manager, Hunting Percival Aircraft, Limited, Luton Airport, Beds., stating age, experience and salary required. [2979

FERRANTI, Edinburgh.—A vacancy exists for an aircraft maintenance engineer at Turnhouse Airfield to be responsible for routine servicing, modification and installation of airborne test equipment on transport and fighter type aircraft. Piston, gas turbine and propeller turbine engines. Experience of A.I.D. or A.R.B. and service stores procedure an advantage. Good prospects. Staff pension scheme.—Apply quoting Ref 29/AME/TID. for an application form, to the Personnel Officer, Ferranti, Limited, Ferry Road, Edinburgh, 5. [2963

SITUATIONS VACANT

SKILLED Airframe Fitters urgently required at Blackbushe Airport. Apply: Chief Engineer, Eagle Aircraft Services, Ltd., Blackbushe Airport, Camberley, Surrey. Telephone: Yateley 2371. [2997

TECHNICAL Assistants of H.N.C. or degree standard required for the Gas Dynamics Laboratory of the de Havilland Engine Company, Limited, Hatfield. Successful applicants will be engaged on research and development in connection with compressors, combustion systems and turbines of jet propulsion units. Good salaries in accordance with age and experience. Good canteen facilities. 5-day week. Please write giving age and full details of previous experience to the Personnel Officer, The de Havilland Engine Company, Limited, Manor Road, Hatfield, Herts. [2967

DEVELOPMENT engineer. Owing to the expansion in the laboratory staff of a large electrical manufacturing organization, vacancies have arisen for development engineers with experience in the design of either AC and DC machines or with a wide knowledge of electro-mechanical devices. The minimum academic qualification required is Higher National Certificate or a degree in electrical engineering.—Applications, which will be treated in confidence, should give age, qualifications and experience and should be addressed to Ref. No. EL.7, stating salary required, Box 0226. [2919

BROOKLANDS AVIATION LTD.

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require

AIRFRAME FITTERS and RATEFIXER

Preference given to Ex-R.A.F. and R.N.A.S. Technicians

Regular work with bonus and Overtime

Apply to:

Brooklands Aviation Ltd., Buttocks Booth, Moulton, Northampton

SITUATIONS VACANT

ROYAL Aircraft Establishment, Farnborough, Hants., require draughtsmen and leading draughtsmen for individual design work. Candidates must have served engineering apprenticeship or equivalent workshop training, have O.N.C. and good drawing office experience. For leading draughtsmen posts, preference given to holders of H.N.C. Salary up to £742 p.a. according to age, quals. and experience. 5-day week of 44 hours including meal breaks. Paid sick leave. 4 weeks' annual holiday, plus public holidays. Writing giving age, quals. and experience to Ministry of Supply, Est. 3.(c), Carlton Hotel, Haymarket, S.W.1, quoting A/M. [2993

SENIOR commercial pilot. A vacancy exists for a licensed pilot experienced on Dakotas and Valettas having not less than 3,000 hours command time on these or similar types. Preference will be given to pilots with current Dove endorsement. Duties involve flying of aircraft associated with equipment trials and also include the flying of a communications aircraft principally in U.K. The post is pensionable and the salary will be in general accordance with B.A.L.P.A. rates. Apply quoting Ref. 29/SCP/TID, and giving full details of training, qualifications and experience to the Personnel Officer, Ferranti Limited, Ferry Road, Edinburgh, 5. [2956

SENIOR development engineer. A vacancy has arisen on the senior staff of a large electrical manufacturing organisation for a senior development engineer. This appointment carries responsibility for a variety of projects, from the design to the production stage and a commensurate salary is offered. The minimum academic qualifications required are Higher National Certificate or a degree in electrical engineering, together with experience in the design of AC and DC machinery and a wide knowledge of electro-mechanical devices.—Applications, which will be treated in confidence, should give age, qualifications and experience and should be addressed to Ref. No. EL.8, Box 0225. [2920

STRESSMEN

Well paid and progressive posts are available for

TWO SENIOR STRESSMEN and TWO INTERMEDIATE OR JUNIOR STRESSMEN

in a large Design and Drawing Office engaged in varied and interesting work on Aircraft, Guided Missiles and general engineering. Salaries from £700 to £1,100 per annum.

Housing accommodation available

Our existing staff are aware of this advertisement.

Applications to Box 498 c/o *Flight*

SITUATIONS VACANT

INTEGRAL LIMITED, Birmingham Road, Wolverhampton, invite applications for vacancies on the design and development staff, the work is on interesting new projects concerning aircraft hydraulic mechanisms. Experience in aircraft component design testing and good technical qualifications are desirable.

WILL applicants please state age, qualifications, experience and salary required. [2914

SITUATIONS WANTED

EX-R.A.F. Signaller; 1,290 hours; first-class F.R.O.'s licence (Temp.); seeks employment, anything, anywhere, preferably overseas; free immediately, any offers?—Box 0524. [2983

CHIEF Engineer; A. and C. licences; 20 years' experience; overhaul, servicing and inspection, mainly light aircraft; Conversant A.R.B., A.I.D. and Service procedure; requires permanent position with progressive company.—Box 0529. [2992

DRAUGHTSMAN, 34, Australian, married, 14 years aircraft factory drawing office experience, including perspective sketching and complete preparation of R.A.A.F. modification orders, competent colour and B. and W. photographer, requires position with established West or South Country aircraft manufacturer.—Box 0446. [2966

FERRANTI LIMITED

EDINBURGH

Flight Trials Division

APPLICATIONS ARE INVITED FOR **ELECTRONIC ENGINEER** for interesting work in their Flight Trials division. The engineer will be engaged on trials to evaluate the technical and operational performance of fire control and navigational systems, air and ground. The qualifications required are to degree or equivalent standard with a minimum of three years' experience. Ref. No. 29/EE/TID.

RADAR MAINTENANCE ENGINEER who will be responsible for a small outstation. Duties will involve limited travelling in the U.K. Ref. No. 29/RME/TID.

Ex Radar Officers and Senior N.C.O.s are invited to apply for either or both vacancies. The appointments are pensionable and offer excellent prospects and working conditions in or attached to our new laboratories.

Apply for an application form, quoting appropriate reference number to the Personnel Officer, Ferranti Limited, Ferry Road, Edinburgh 5.

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Suppliers of **machined** *and* **fabricated components** *in all Plastic and Allied materials to individual requirements. Precision guaranteed.*

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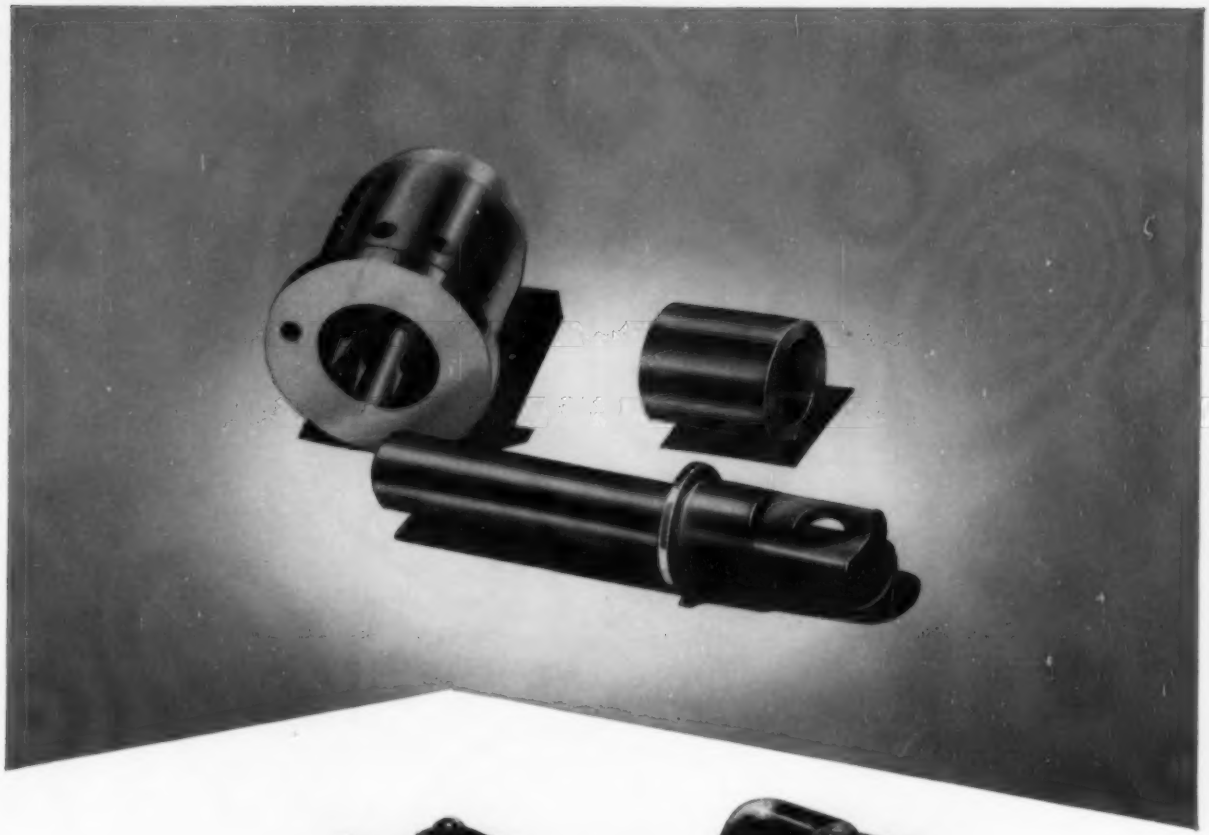

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GUIDED MISSILES

IT is still uncertain whether the aggressor or defender will hold the initiative in combat with guided weapons. Pilotless interceptors show great potentialities, but on the other hand pilotless bombers may have to be attacked and outmanoeuvred at three times the speed of sound. These are not academic problems. In our defence we and the NATO partners require to invent weapons that can fly, and indeed think, automatically at 2,000 mph. Though missile development is a single technology it is at the same time a synthesis of three sciences—one involves supersonic aerodynamics and servo mechanics, another is miniature electronics, and the third concerns novel propulsion systems. At supersonic speeds air, instead of flowing round the structure, becomes intransigent and so the familiar lines of the jet aircraft give way to the sharp, needle-like appearance of missiles that must force a path through air when it behaves like an unyielding fluid. The electronics systems are intrinsically complex and the task of making miniature components—microtronics is the new word—and re-designing them to work in high temperatures is as difficult as the original research required to establish their feasibility. The day is coming when not only the radio valve but its associated components will be replaced by a speck of matter. Hundreds, and perhaps thousands of radio valves are needed for airborne computing, navigational and guidance systems if the missile is to perform automatically and work out continuously its own best strategy. But instead of filling up a large room all this may soon be compressed into printed circuits measuring but a few inches. In the propulsion field more and more thrust can be extracted from within progressively smaller envelopes; indeed the extraordinary point has now been reached when 10,000 equivalent thrust horsepower and more is to be wrung from a simple tube 12 or so inches in diameter. In each of these different aspects of missile development the arrangement of small, and in some cases microscopic, pieces of new materials such as titanium and germanium present boundless capabilities.

The financial responsibility of building one science within another has naturally been complicated by the fact that missile facilities had to be superimposed on those already required for the production of air exports and manned air weapons. The development of missiles has, in practice, depended largely on the major prime contractors. The Bristol Aeroplane Company was one of the pioneers in automatic air warfare: it took years to persuade some early test vehicles to fly straight without tumbling. After that they had to be controlled, then made to control themselves and fight automatically.

All this is a job that must be done. The sooner such weapons are perfected the safer we shall be because, as Sir Winston Churchill has said, the more powerful these air weapons become, the less chance there is that any aggressor would dare to use them.

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